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31 AUG 1932

VOL. XXX. PART 8

The JOURNAL of AGRICULTURE

Of The Department

VICTORIA AUSTRALIA

AUGUST 1932 Price 3d.

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Issued under the direction of the Hon. J. Allan, M.L.A., Minister of Agriculture.

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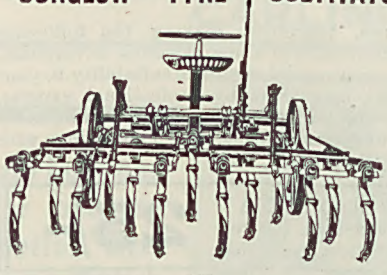

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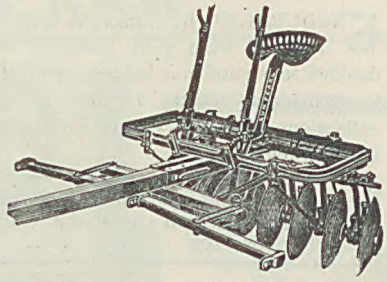

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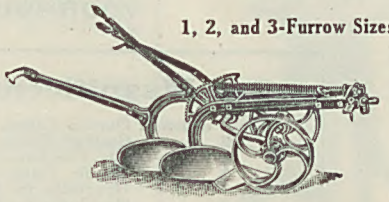

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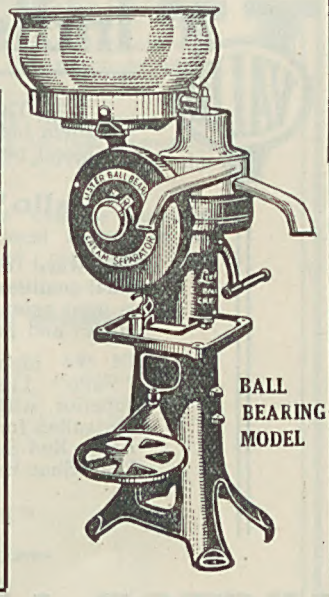

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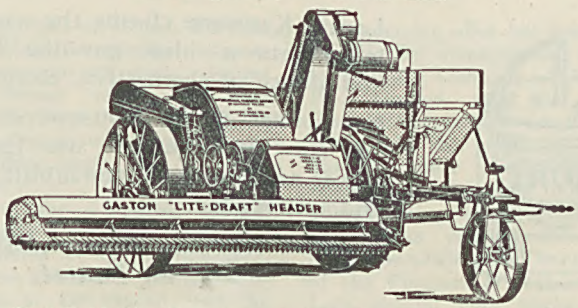

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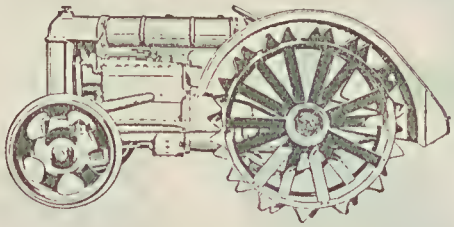

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The Journal of the Department of Agriculture of Victoria

Botulism in Horses

Forage Poisoning and the Mouse Plague

By R. N. Johnstone, B.V.Sc., Senior Veterinary Officer.

DURING the past three or four months the Department of Agriculture has received many reports of sickness occurring amongst horses in the northern wheat-growing areas, and individual farmers or groups of farmers have asked that a veterinary officer visit their districts to investigate the nature and cause of the disease and to advise how the affected animals may be cured and further outbreaks prevented.

Because of the very limited number of veterinary officers available, it has not been possible for one to visit every centre from which applications for assistance were received, but many inspections have been carried out, and as a result we are able to state definitely that the trouble is due to botulism or the so-called forage poisoning.

There has been a tendency recently amongst stock-owners to ascribe many deaths of stock from causes not known to them, to forage poisoning, and as a result we find many quite dissimilar diseases bearing this name; we find also that the name in one district has a meaning quite distinct from that in other districts. For these reasons, I think the term should be used no longer, and the various diseases now vaguely spoken of as "forage poisoning" should be called by their correct names.

Botulism or para-botulism is the term applied to a particular kind of food poisoning resulting when animals eat food containing a poisonous substance or toxin produced by a certain microbe which grows and multiplies in damaged fodder or in the carcasses of dead animals. Like many other diseases, it is caused by a microbe or germ, but it differs from most of these diseases in that it is not necessary for the organism to enter the animal body; the microbe does not increase or multiply or liberate the poison in living tissue, but attacks dead tissues only. The microbe is known as *Bacillus botulinus*. When growth has ceased because of lack of food or moisture, the organism enters a resting or spore stage. It is then very resistant to outside influences, and will retain its vitality even when dry, and thus may be carried about in dust or other dry material.

Symptoms.

The symptoms of the disease vary somewhat, but in general they are as follow:—The animal becomes dull and listless, and there are irregularities in its gait; it may knuckle over and stumble or trip as it moves along. The eye is noticeably dull, and the head seems to be "heavy." The staggering becomes worse; the animal does not respond to commands, and eventually, after having lain down, it is unable to rise, as a paralysis of the hindquarters has developed. Sometimes a sick horse will eat and drink normally, whilst

others quickly sink into a semi-comatose condition, and death will take place in a few hours. In those cases in which the patient eats and drinks the disease will run a chronic course over a period up to several weeks if slinging is resorted to.

Although horses are most commonly attacked, since they are more often fed on prepared fodder, viz., chaff, hay, or grain, the trouble is by no means uncommon in cattle, and even sheep and pigs may be affected at times.

The disease is not infectious nor contagious, that is, it is not transferred from one live animal to another. It is usual for more than one animal to be affected at a time, but this is simply because many animals have access to the poisonous forage at the same time.

Conditions necessary for growth of the organism.

Warmth, moisture, and absence of air are essential for the organism to grow and multiply. It is carried about in soil, dust, and water, and derives its nutriment for growth and multiplication from decomposing matter. It is the fact that absence of air is necessary that prevents the complaint from being more common than it is. It is found, however, that the microbes can grow in fodder exposed to air, provided that moulds are present. Moulds require both warmth and moisture and also air, but immediately beneath the mould the air is used, and thus the condition is suitable for the multiplication of the *Bacillus botulinus.*

At one time it was thought that the disease was attributable to the moulds, but whereas mouldy fodder itself may produce slight digestive disturbance without contamination of the *Botulinus bacillus,* it will not produce this disease which we now term botulism.

The relation of Mouse-contaminated Fodder to the disease.

The nests of mice and the bodies of dead mice form ideal conditions of warmth and moisture for the growth of moulds and other organisms, and if the *Bacillus botulinus* be present then multiplication and the production of poison will result.

These facts explain why the disease is more prevalent in plague years, when it is a difficult matter to protect hay, chaff, and grain from contamination by mice. In times of drought also large numbers of cases occur, for consequent on scarcity of good fodder, damaged hay and grain are used for feeding stock.

A likely source of fodder contamination is the dust that drops into the mangers from straw-covered stables; another way in which it is spread is by the water-soluble poison being carried through straw roofs during rainy weather, and thence finding its way into the feed. These old straw roofs form good conditions for vegetable decay as well as a harbour for mice and birds.

It is possible also that mice may carry the microbes from the soil into chaff or hay, and there they may grow and multiply in and around the mouse nest and develop the toxin; and, further, the mice may carry minute pieces of decomposing vegetation impregnated with the poison into clean, sound fodder.

The disease occurs during the warmer months of the year—summer and autumn—especially if there be wet and humid periods. There may be sufficient moisture in the fodder itself, or the dry fodder, may become wet by rain during harvesting or storing operations. Ensilage is especially liable to develop the poison owing to its being a wet fodder and maturing in an atmosphere free from oxygen.

Grass Pasture Infection.

It is interesting to note that outbreaks of this trouble have been reported where animals were not hand-fed, and had not access to decaying vegetable refuse around stacks, &c. As a result of investigation, it has been found that the poisonous fodder consisted of dead and decaying grass found at the base of tussocks and tufted grasses which grow in moist places such as swamps and creek and river flats; mouldiness is often seen around the butts of such tussocks, and this is a condition suitable for the development of the microbe's poison.

Other material in the field in which the germ will thrive is cocky-chaff from winnowing during harvesting or threshing operations; this, if left in the field, may become wet and matted, and as it decomposes, become infected.

Damaged butts of stacks should always be regarded with suspicion; it is a risk to feed them to horses and stock; one would be better advised to burn them. It is very necessary that stacks when opened should be protected from rain.

Three important facts concerning this poison are—

1. It is one of the most powerful poisons known.
2. It is soluble in water.
3. In common with other bacterial poisons, it produces its effects only after a definite interval, which is from three to seven days.

Owing to its solubility, the poison may be washed from the part where it was produced to an apparently clean portion of the fodder.

Further, owing to the interval of time, may-be several days, between the eating of the fodder and the development of symptoms, it will perhaps be difficult to obtain a sample of the truly poisonous fodder.

A summary of the important points on this subject are—

1. The fodder is usually mouldy or has been contaminated by mice.

2. Warm rains in summer and autumn falling on the fodder, and followed by warm weather, are frequently responsible for the growth, both of the moulds and the poison-producing microbe.

3. Even mouldy fodder is poisonous only if the particular microbe is present.

4. Damaged fodder should not overlie sound fodder, nor should feed mangers be exposed to contamination from old straw roofs.

Treatment, Etc.

This disease has a particularly high mortality; indeed, but few affected animals recover.

Where horses lapse into coma or unconsciousness nothing can be done, and farmers with experience of the disease usually resort to the friendly bullet. In those cases, however, in which the animal is fairly bright and eager to eat, drink, and make a bid for life, it is recommended that it be placed in slings and fed on a laxative diet—green feed, small bran mashes, &c.

It should be noted that slinging is quite useless unless the patient is able to stand, the sling being used to prevent its falling down.

Warm, soapy water enemas may be given several times a day, and Epsom salts from two to four packets may be dissolved in the water with which the mashes are made.

The following mixture may be given:—

Pulv. potassium nitrate	.. 1 oz.
Pulv. sod. salicylate	.. 1 oz.
Pulv. red cinchona bark	.. 1 oz.
Pulv. nux vomica ..	.. 2 oz.
Pulv. ammon. carbonate	.. 4 oz.
Pulv. linseed meal	.. 3 oz.

Mix and divide into twelve powders. One powder should be mixed with treacle and water, and pasted on to horse's tongue with flat stick each morning and evening.

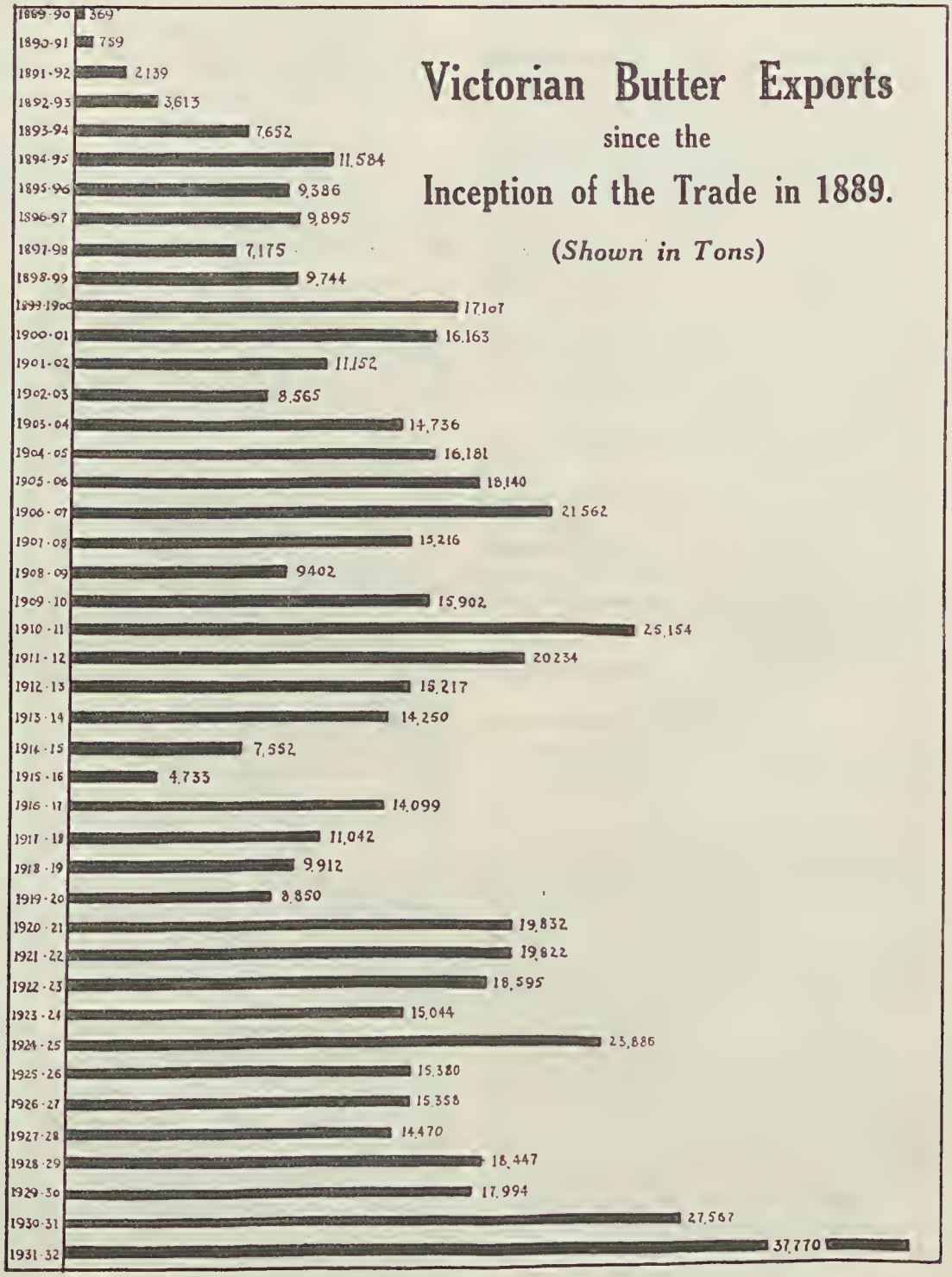
Control of the Disease.

In discussing this disease, the old maxim which states that "prevention is better than cure" is particularly apt. If sound fodder only be fed to stock the complaint will not occur; therefore, it is necessary to take every precaution to protect hay, chaff, and grain from damage by rain or by mice. If damage does occur, then to be on the safe side, any damaged portion should not be used. Fodder known to be infected should be burned. Stables and barns should be constructed so that fodder once placed therein will not become affected; it is recommended that old straw-roofed stables be burned, or else that the roof be replaced by galvanized iron. There should be a general cleaning up of straw and other refuse around the stable.

Paddocks in which there is tufted or tussocky grasses should be burned during the autumn if there is any suspicion that they are affected.

The investigation which led to the discovery of the poison-producing organism was conducted by Dr. H. R. Seddon, formerly of the Melbourne Veterinary Research Institute, and now Director of Veterinary Research in New South Wales; further knowledge has been brought to light by members of the veterinary staff of the Victorian Department of Agriculture.

Dr. Seddon produced an anti-toxin which experimentally gave good results, but the irregular incidence of the disease renders the maintenance of a sufficient supply a very difficult matter. Steps have been taken by Dr. Albiston, of the Veterinary Research Institute, to manufacture a supply for use in the present outbreak. Meanwhile, farmers would be well advised to exercise the greatest care and maintain a very close supervision over the fodder used for feeding their stock, not forgetting that a thin horse is always more useful than a dead one.



Graph showing Victorian Butter Exports. *(See opposite page.)*

Butter Exports and Fodder Conservation

By R. Crowe, Director of Agriculture

Carting Rye-Grass Hay.

THE accompanying graph showing Victorian butter exports since the inception of the trade in 1889, discloses how irregular have been the quantities available for shipment each season. The differences were due mainly to the nature of the seasons experienced, a prolific year being the rule when the rains were plentiful and fell at opportune times, while poor results accompanied seasons in which the opposite state of affairs was experienced. It will be seen that there were eight production "peaks" and seven "gulfs" at almost regular periods, and in studying this graph one cannot escape the conclusion that these periodic drops in production could have been greatly minimized had provision been made for the conservation of fodder, so that there would be ample feed for the dairy cows all the year through.

When travelling through dairying parts of the State, it is refreshing to see at some places fodder saved and protected from the weather. In odd cases, unfortunately, one sees stacks which were badly built, with the result that huge waste was obvious, and it is lamentable to think that farmers who had the foresight to cut and stack hay, for the want of a little extra attention, have allowed 20 or 50 per cent. of their effort to be wasted subsequently.

It would be safe to say that the majority of dairymen still appear to have little or no thought for the future. There is no indication that they have made any effort to conserve the surplus growth or grow fodder to supplement the pasture. In some districts, in January or February, one may travel for miles and see dry grass, almost the whole of which not only will go to waste but is also a serious danger on account of fire during the summer time.

Dairymen and stock-owners generally would be well advised to subdivide at least portion of their farms where such is not already done, and harvest some of the surplus growth in the form of hay or ensilage. Fodder crops also should be grown for this purpose.

It will be seen from the graph that the last two seasons have been the most prolific yet encountered, and it is probable that a normal season is again due. It should be remembered that over the period from the 1st January to the 31st May of this and last year the rainfall was 3 inches more than the average for that period for 76 years. It is too much to expect that we will be blessed with a similar happening next year. Therefore, all dairymen and stock-owners would be well advised to take steps towards conserving an abundant supply of fodder to enable them to minimize the effect of a normal or sub-normal rainfall.

What a calamity it would be for the State and the dairying industry if we were to experience again a fall in production as is indicated in the graph between the seasons 1910-11 and 1915-16, when production receded to the level of the "nineties."

Tobacco Growing

Excise Act Requirements

THE Collector of Customs has asked that the requirements of the excise law should be brought under the notice of tobacco-growers, and the main features are set out briefly hereunder:—

1. There is a £20 penalty for growing tobacco not covered by registration when the crop is planted.

2. The owner or the lessee of the land is the proper person to be registered.

3. Share farmers or partners are covered if the owner or the lessee be registered.

4. Application forms are obtainable from the Collector of Customs, Melbourne, who effects registration when application is made.

5. No fee is charged for registration.

6. Leaf may be grown only on the areas in respect of which the grower is registered.

7. A grower can store his leaf on his own premises, but not elsewhere without the Collector's permission.

8. A registered grower may sell leaf of his own production only. He is not permitted to buy leaf from any other person, and may sell leaf only to licensed dealers and manufacturers.

9. No person other than a registered dealer or a licensed manufacturer may trade in leaf.

10. A grower must keep an account of all leaf produced and disposed of, and must furnish a return setting out his operations not later than the 15th day of January following the harvest period. Total failure of a crop must be notified in the return.

11. A grower who ceases to grow must at once notify the Collector or continue to furnish annual returns.

12. No person, other than a licensed manufacturer, is permitted to prepare tobacco for smoking, under a penalty of £100. Hence, a grower or any other person who prepares tobacco even for his own smoking renders himself liable to a heavy fine.

Heavy penalties are prescribed for failure to conform to the law in any of the above matters. In the past, owing to the comparatively small number of growers, the greatest leniency was extended to defaulters. With the huge expansion in the Australian leaf industry, effective control can be carried out only by a strict observance of the law, and definite instructions have been received that offenders must be punished.

The Sheep Industry

Helpful Hints to Sheep-men

3.—Classing the Clip.

By N. A. Bowman, Sheep and Wool Expert.

[*Previous articles of this series, which appeared in the June and July issues of the Journal, dealt with the selection of ewes and rams and lamb marking.*]

A MISTAKE frequently made by wool-growers is to place their clip on the market without paying proper regard to its preparation and get-up. Prices ruling at present are so low that growers cannot afford to neglect any avenue that holds promise of increasing their returns. Wool competently and thoroughly classed commands the highest prices, and it will pay the grower to exercise every care in this direction, and in making his clip as attractive in appearance as possible.

Keep the Wool clean.

Where possible, yards should be watered before using; this will tend to keep the dust from rising and entering the wool. Dust in wool may reduce its value by as much as 2d. per lb. It has been noticed frequently that some wool-growers take infinite pains to keep their sheep clean throughout the year, but at shearing time allow them to run through dusty yards.

Some districts are naturally dusty, and there it is impossible to keep the wool clean, but it must be remembered that there are two degrees of dustiness—just dusty and very dusty. Whatever district he is in the grower should try to keep his wool as clean as possible. The more dust, dirt, &c., that finds its way into the wool the lower will be the return.

Skirting and Rolling.

Before shearing commences the shed should be clean and all gear in good working order.

As soon as the belly wool is off, pick it up; if from a wether, remove the stain. Always keep urine stained wool separate, as this is a permanent stain, and will not scour out under ordinary conditions.

When the shearer lets go the fleece it should be picked up by taking hold of the two hind legs, which should be lifted up, then doubled back and drawn round the rest of the fleece. The fleece should then be carried to the table and thrown out, the neck being allowed to go forward.

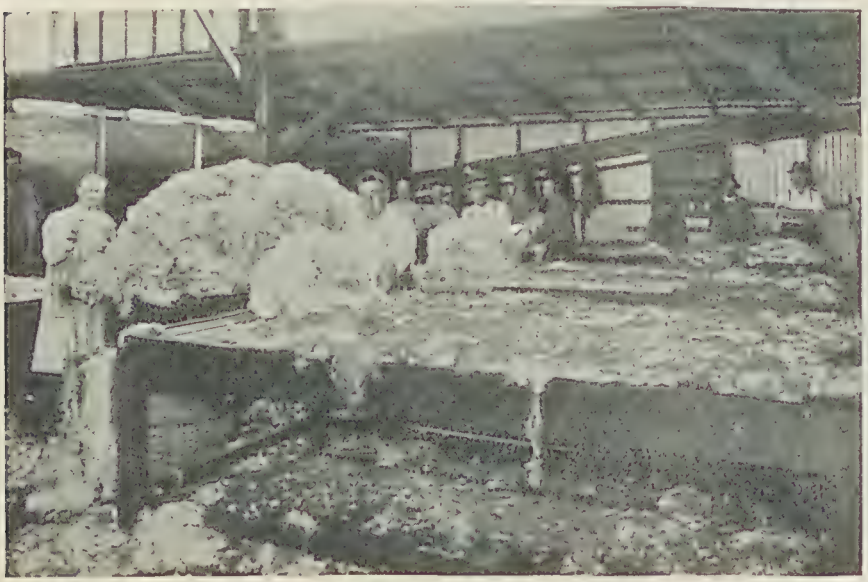
The objects of skirting are to remove all that portion of the fleece below the average type or quality of the fleece proper, and to leave the remaining portion of the fleece as even and as uniform in length and quality as possible. The actual skirting of the fleece will be governed by four principal factors:—

(1) The class of wool, i.e., whether Merino, fine, comeback or crossbred;

(2) The quality of the wool, i.e., whether good, poor, or inferior;

(3) The condition of the wool, i.e., whether free or burry; and

(4) The number of sheep of the one class to be shorn.



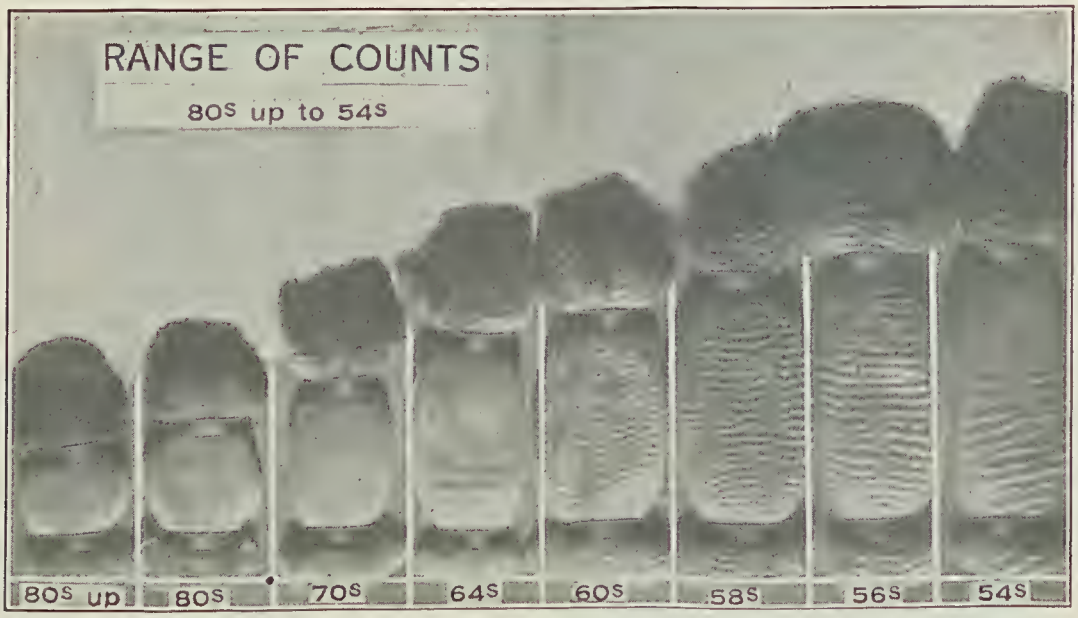
It is sometimes said that it does not pay to skirt wool, as although the skirted wool brings a better price, the increase is not sufficient to compensate for the loss in weight. Occasionally, one hears the remark, "So-and-so skirts and classes his wool, yet he gets no more for it than I do for mine."

To the first statement the reply is that speculators will buy unskirted wool, skirt and roll it,

and sell it again at a profit — surely a sufficient proof that it pays to skirt. Of course the skirting must be done properly, and no fribby ends should be left on the fleece, nor should more wool than is necessary be taken off them. In answer to the second statement, it may be pointed out that, to many people with no technical knowledge of wool, one fleece may seem almost the same as another, yet to the practical buyer and valuer there may be a difference in yield of anything from 4 to 8 per cent., which would mean a considerable difference in the value of each fleece. All wool is bought on a clean-scoured basis, that is to say, the buyer considers the count or spinning quality of the wool, and its probable yield, and the price is arrived at on the clean-scoured limits of that class of wool on the date of purchase. Take, for instance, a bale of merino, 64's quality, yielding 50 per cent, i.e., half is wool, the other half consists of yolk, dirt, &c. If wool of that quality is worth, say, 28d. clean-scoured, the value of the greasy wool will be 50 per cent. of 28d., i.e., 14d. per lb. From this amount, charges for commission, &c., must be deducted.

If fleeces be properly skirted, that portion remaining on the table will be of fairly uniform quality. Thus any one buying or selling can estimate its value easily and quickly.

The method of skirting is as follows:—Skirt from the rear of the forelegs towards the neck, taking off all sweaty locks and burr if they be light; if heavy, leave on and skirt lightly, not taking off any wool as good as the main fleece. Having skirted up to the neck on both sides, turn the fleece down level with the shoulders, and skirt both sides down to the britch. Should the hind legs or britch be inclined to be hairy, skirt the wool all off. Then turn britch up one-third of the way, and throw one side right across the table to the other; the operator should then take the back, which is now in the centre of the table, over towards himself, and roll the fleece from britch to neck. In this way all the shoulder, neck, and rib wool, always the most attractive portions of the fleece, will be exposed to view; and the flock-owner should always make a point of showing the best part of the wool. A common method is to throw both ends in, and then put both sides to the centre, and roll the fleece up and down the centre of the table. The drawback of this method is that it leaves exposed all the back wool.



Classing.

It is just as big a mistake to overclass as to underclass, and the putting up of star lots should always be avoided.

A farmer going into the market to-day and purchasing, say, 500 young comeback sheep or comeback sheep not station bred, will find, almost invariably, when classing their wool, a fair percentage of quarter-bred and half-bred fleeces. In many instances such wool is all put into one class and branded comeback. A buyer seeking comeback wool, on examining such an ill-assorted lot, refuses to bid for it. Competition is thereby lessened, and often this badly classed wool falls into the hands of speculators, who class it into even lines suitable for the trade, and thus make a profit.

Growers should class their wool evenly and honestly, and bales should be pressed neatly and branded clearly. Wool so presented certainly will command more spirited competition than if it is badly classed and packed.

In classing merino wool, the determining factors are length, condition, quality, and soundness; in crossbred wool, quality is the main feature.

The following tables will give an approximate idea as to the number of lines into which wool should be classed. Perhaps all that need be added is to impress upon farmers that they should always try to make a four-bale lot or more out of their top line:—

Merino.

TABLE No. 1.—Up to 100 Sheep.

1st MER.	All well-grown fleeces, light to medium, sound condition.
MER.	All short, tender, or shabby fleeces.
PCS. & BLS.	In same bale (with bag between). Bag stain, also locks, and press in top of bale containing the Pcs. The brokers should be notified of what this lot consists.

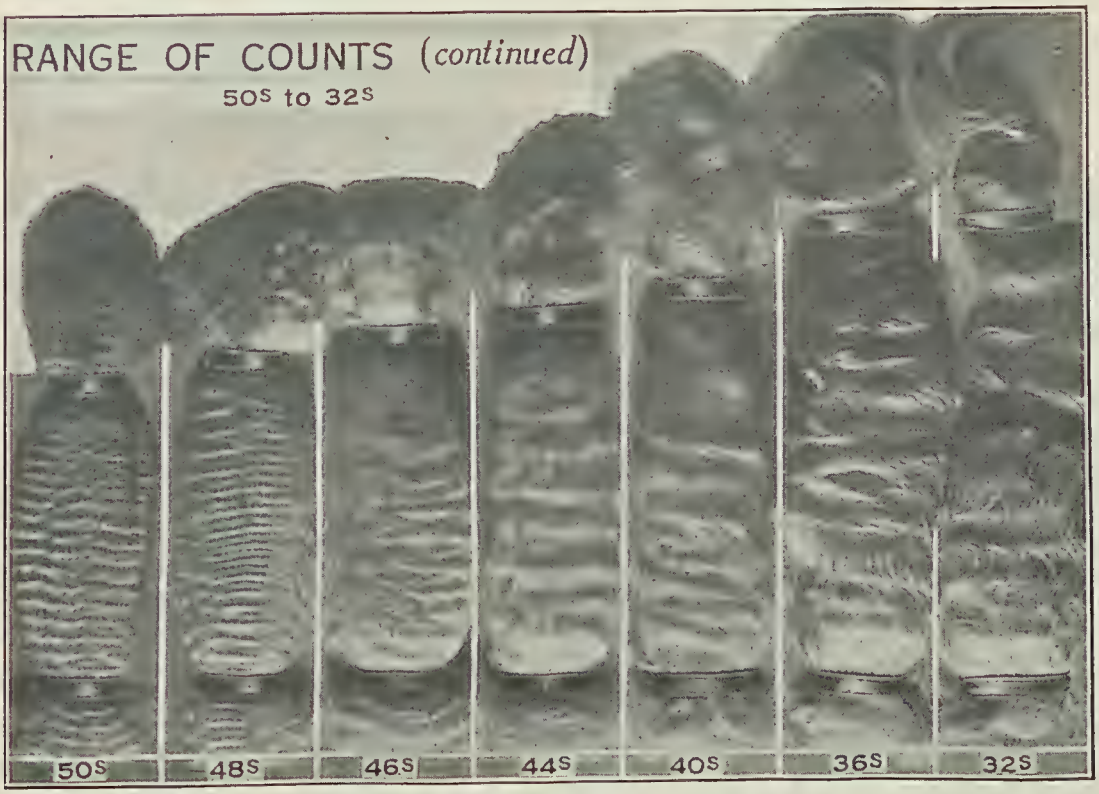
TABLE No. 2.—100 to 500 Sheep.

1st COM.	All well-grown fleeces of medium to light condition.
COM.	All short, tender, and shabby fleeces.
A.A. COM.	All strong quality fleeces.
1st PCS.	Best of the skirtings.
PCS.	Seconds and all coarse Pcs.
BLS.	
LKS. & STN.	In same bale (with bag between). The broker should be advised how lot made up.
100 to 500.	Lambs—Just keep hairy britch ends stains and sweaty locks out.

TABLE No. 3.—1,000 to 2,000 Sheep.

1st COM.	Good length, sound, fairly bright.
COM.	Shorter, sound, a little heavier conditioned.
A.A. COM.	Strong wool.
MER.	Tender and inferior.
BKN.	Best of the necks.
1st PCS.	Best of the britch.
PCS.	Seconds of both.
LKS. & STN.	

Keep neck and britch wools separate when skirting.



Comeback.

TABLE No. 4.—Up to 100 Sheep.

1st CBK.	All well-grown fleeces, fairly fine.
CBK.	All fleeces stronger in quality. Bag shabby fleeces, also Lks. and stain, and press them in top of bale containing Pcs. and Bls., and so advise brokers. Care should be taken that contents are on bags.
Up to 100.	Lambs—Bag stain and britch ends and brand the balance lambs.

TABLE No. 5.—100 to 300 Sheep.

1st CBK.	All long, bright fleeces, well grown.
CBK.	All short and shabby wool.
FXB.	All strong quality fleeces.
1st PCS.	All fine pieces.
PCS.	All strong quality wool.
BLS.	
LKS. & STN.	In same bale (with bag between).
1st LMS.	All bright and fine lms.
LMS.	All short and sweaty ends, &c. Bag all coarse britch ends and stain.

TABLE No. 6.—500 to 1,000 Sheep.

1st CBK.	All long, bright, and fine fleeces.
CBK.	Same, only heavier in condition.
A. CBK.	All short and shabby.
FXB.	All coarse quality fleeces.
CBK. PCS.	
FXB. PCS.	
BLS.	
LKS. & STN.	
1st LMS.	Bright, fine, and good length.
LM.S	Short and sweaty ends. Bag coarse and stained.

In classing most mixed Crossbred clips it is practically impossible to avoid star lots owing to the large range of quality; the only way to do so is by purchasing sheep with wool of as nearly even quality as possible.

Mixed Crossbred.

TABLE No. 7.—Up to 100 Sheep.

FXB.	Put Cbk. and ¼B wool together.
XB.	All the coarser fleeces. Put Bls. and Pcs. together. Bag locks and stain.
LMS.	Just keep stain out.

TABLE No. 8.—100 to 500 Sheep.

CBK. ¼B. ½B. ¾B. CXB.	Straight grades.
FXB. PCS.	All skirtings from Cbk. and ¼B.
XB. PCS.	All skirtings from the coarser fleeces.
LKS. & STN.	In same bale (with bag between).
FXB. LMS.	All Cbk. and quarter bred.
XB. LMS.	All coarser wools. Bag stain.

Table No. 9.—500 to 1,000 Sheep.

CBK.	Pcs. from Cbk. and ¼B. brand FXB, PCS
¼B.	
¼B.	Pcs. from ¼B. brand MXB. PCS.
¾B.	Pcs. from ¾B. and CXB. brand CXB. PCS.
LXB.	
FXB. PCS.	Pcs. from CBK. and ¼B.
MXB. PCS.	Pcs. from ½B.
CXB. PCS.	Pcs. from ¾B. & LXB.
FXB. BLS.	Fine.
XB. BLS.	Strong.
FXB. LMS. MXB. LMS. CXB. LMS.	Throwing out all stain, &c.

Spinning Qualities.

Spinning qualities are determined by the actual diameter of the fibres, together with other characteristics that make the difference between good and bad wool. A high quality wool must have handle, character, elasticity, density, and also be abundantly grown and pleasant to the touch, without being over soft. With wools having these characteristics, the determination of the "Count" or "Spinning quality" from the grower's point of view becomes comparatively simple. The most important of the above factors for the determination of quality is the crimp or character, providing of course that it is even and well defined throughout the entire length of the staple. The more crimp to the inch, the finer the wool, and in the accompanying plates differences in this particular feature can be readily observed. The estimation of the quality of wool is a matter of judgment, and to be sound in that judgment requires years of experience.

Baling and Pressing Wool.

Place the bale with the sewn seam to the fixed sides of the press. Fleeces should be placed as carefully as possible, from 35 to 50 in each; these should make a bale of about 280 or 290 lb. 250 lb. of greasy Merino wool, or 225 lb. of CBK. or XBD., gives what is recognized as a bale. Light-weight bales must be guarded against.

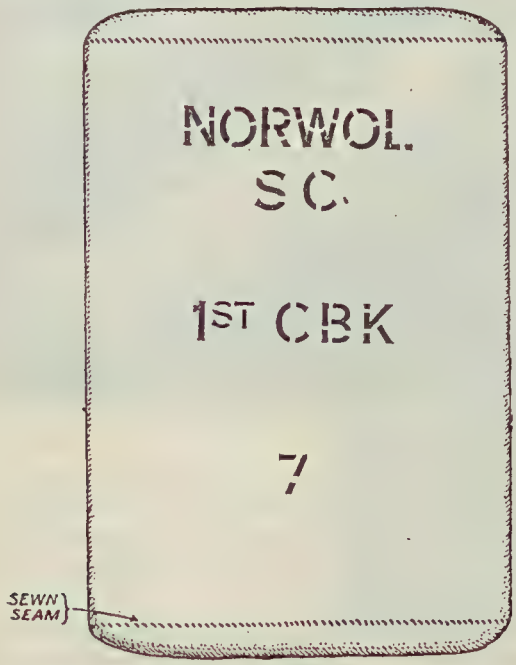
Specification List.

Brand.	Description.	Individual Numbers.
1st Com.	Good length, sound, fairly bright (a little more dust than usual or any other feature due to seasonal conditions)	1, 4, 9, 10 19
Com. ..	Shorter, sound, with a little more condition	2, 5, 8, 11, 17
A.A. Com.	All strong quality wool ..	7, 14, 18
Mer. ..	Tender and inferior fleeces ..	3, 16
Bkn. ..	Best of the neck skirtings } All skirtings free from stain	6, 12
1st Pcs. ..	Best of the britch skirtings }	13, 15
Pcs. ..	Seconds of both }	
Lks. & Stn.	.. ..	20

Wool-pressing

Bales *should be branded distinctly* on the square side, first the *brand*, then the *class*, then the *number* of the bale. On the *top* put the name of property and the number only.

Always at the completion of shearing forward to your wool brokers *a specification list* in the manner shown above.



Side of Bale showing Method of Branding.

Technical Terms.

Badly Bred Wool.—One in which the fibres are straight, thin, and inclined to be irregular.

Break.—Weakness in portion of the fibre, though above or below this break the fibre may be perfectly sound.

Brightness.—Applicable to the wool of the Merino and Polwarth; clean pure colour; bright without brilliancy.

Broad-Fibre.—Fibre appears thick and straight, devoid of elasticity; harsh unyielding nature; may be termed coarse.

Carbonising.—The extracting of vegetable matter from wool and waste after converting it into carbon by such agents as sulphuric acid.

Cast.—A line made in classing of all the low conditioned wools; also dingy, short, rough and badly bred wools.

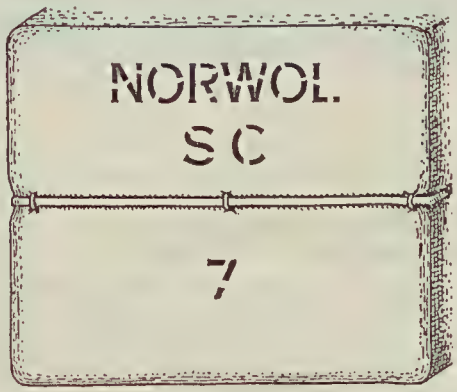
Character.—Generally speaking, the term is applied to any wool showing a crimpy formation true from butt to tip, though, of course, all wools possess their own character. Lack of character is found in ill-bred common wools, the manufacturing value of which is low.

Crimp.—Undulations or wavy formation seen on the wool fibre.

Density.—This has two applications—one relating to the structure of the individual fibre and the other to the fleece. The former means that the structure is very dense and of compact nature, and as a rule the finest fibred wool is the most complex in its build. Density as applied to the fleece implies that the growth of wool is very close or compact. The fleece carrying the greatest number of fibres on any given area of pelt would possess the greatest amount of density. The important point to the wool-grower is the amount of wool that can be grown on each individual sheep. Grasp a handful of the fleece and notice its capacity to "fill the hand." Also divide the staples—with a dense woolled sheep the parting does not reveal a broad expanse of pelt.

Dingy.—Of a heavy, dull, shabby appearance.

Doggy Wool.—Wool showing hard, straight, bright and broad-fibred features. To the untrained eye this wool appears attractive, and often finds its way into "top lines."



The end of the Bale.

Elasticity.—The power of returning to its original position after stretching—one of wool's most outstanding characteristics. The fullness of handle for which wool is noted is to a very great extent due to its elasticity. Owing to this property wool is often described as having two lengths—the "apparent length" and the "true length." Elasticity is mainly created by the crimpy formation of wool, and is an essential if wool is to be woven into good material.

Evenness refers to a fibre that is even in diameter throughout its whole length. It is also used when speaking of a flock of sheep similar in type and appearance.

Fineness relates to the diameter of the fibre.

Free.—(1) Free from all extraneous matter in the shape of burrs, &c. (2) Free from all traces of cottedness (matted).

Harsh. — Applied to a wool that is harsh and crisp to handle—unkind to the feel.

Hungry.—Of a lean, delicate appearance.

Handle.—This term denotes the degree to which all the factors which comprise quality, such as softness, fineness, length, elasticity, and density are noticeable when wool is judged by the feel.

Display of Wool on Broker's show-floor.

Kemp.—These fibres are comparatively short, thick and straight, and the colour is a flat white and opaque. Kemp fibres first make their appearance in the wool grown about the head and britch of the sheep. The fibre is shed at different periods, and can be seen floating in the wool fibres detached from the pelt. Under the microscope the structure shows a very marked medulla or central core with a comparatively smooth surface, and lacking any crimpy formation or serrations.

Lustre.—The glossy or shiny appearance which Mohair, Alpaca, and some English wools possess, owing to the reflective powers of the large serrations, which cause materials made from them to look bright.

Masculinity.—Applied to a wool having strength; stout, valuable for stud purposes.

Mushy.—Wool that is dry, open, and badly defined in staples. When combed will noil heavily.

Mongrel.—Mixture of many breeds of sheep, dogs, &c.

Noil.—The short fibre extracted from the long during the combing process in worsted manufacture.

Over-grown.—A wool of fifteen months' growth or upwards.

Plain Wool.—Wool in which the crimp or waves are scarcely discernible. Also wools in which the staple formation has ceased altogether, and the fleece is only lightly held together by binders.

Serrations.—The outer scales of the wool fibre or saw-like edges which project from the body of the wool fibre, and which, during the milling operations, assist in the felting of the wool by interlocking.

Shafty.—Having a bold, strong, lengthy, and densely grown staple.

Sound-Wool.—Wool of quality or breed, and also one which will withstand tension, and will not break when pressure under 6 lb. is applied.

Tender-Wool.—A wool with an abnormally weak staple.

Top.—Name given to wool in a semi-manufactured state. Wools which have been treated by scouring, carding, and combing are known as "tops."

Untrue Wool.—Implies irregularity of formation in crimp, and in diameter of fibre.

Yield.—Clean scoured, the actual weight of wool returned from the scour with all the grease, dust, &c., removed, but possibly with burr and seed remaining in it. *Carbonized Yield.*—Similar to above, but perfectly free from all vegetable matter.

Potato Growing

Preparations for Planting

By J. T. Ramsay, Potato Expert.

IN outlining the cultural operations by which land intended for a potato crop may be prepared, it is impossible to lay down any hard and fast rule which would suit all sorts and conditions of soil. This is so because there is such great variation in the soils, which may be of sand, clay, or any of the many gradations between these two extremes.

Boxed Seed Potatoes Ready for Planting.

Again, varying climatic conditions demand varying treatment, and the times at which different classes of soils can be treated most advantageously will differ in the several districts. Notwithstanding all these variations, the object to be aimed at in preparing land for a potato crop, or any other crop demanding intense culture, is the correct mechanical condition of the soil or, in other words, the correct tilth.

Many land-owners possessed of country which is naturally very fertile do not seem to appreciate the necessity of producing this condition of soil for the reception of seed. They appear to think that since they are planting seed in rich land, little more is necessary. Soil may be rich, and yet be in such a poor physical or mechanical condition as to render it entirely unsuitable for the free development of plants of high economic value.

The production of genial conditions for the reception of the seed of the potato crop is secured by the utilization of such implements as will reduce the soil to a condition or tilth which will make it amenable to the needs of the crop. There are several good reasons why this particular mechanical condition of the soil is essential. First, such a condition allows the roots of plants to branch out without restriction in search of food; secondly, useful bacterial activity is encouraged; and thirdly, percolation of water is promoted and evaporation of moisture retarded.

Wherever the depth of the soil will permit, the first ploughing should be to a depth of 7 to 9 inches, and the second about 2 inches shallower. There are many cases where the top soil is so shallow that this depth is out of the question. On land where the surface soil does not extend below from 5 to 6 inches, care should be taken not to plough to a greater depth than surface soil.

In addition to the mould-board plough, the disc or spring-tooth cultivators, the roller, and the harrows, all play an important part in the production of a good seed-bed. After the second ploughing the disc or spring-tooth cultivator should be used to further break down the soil. It is possible that only one or two strokes of the cultivator will be required to produce

the desired effect. However, it is always well to err on the side of over-cultivation rather than under-cultivation.

It is not necessary or advisable to work the soil down too finely, as in the event of heavy rain falling it is liable to run together and become so closely set as to necessitate the whole of the ploughing and cultivating being gone over again.

Under normal conditions, however, if two ploughings and two disc or spring-tooth cultivations are given, the land may be allowed to lie in that condition until the time of planting. In the event of rain falling in any quantity subsequent to these operations, opportunity should be taken, as soon as the ground is in fit condition to carry horses or tractor, to run over it again with one or other of the cultivators. Harrowing at this stage is not necessary, and should be left until just before planting commences.

It is important at this season of the year to go over seed stocks in order to prepare them against the approaching planting times. Seed in boxes will require very little attention, as seed so stored keeps in the best of condition. But it is just as well to look over these lots and remove any tubers which have dried off as the result of injury received at digging time from the fork or machine, and also any showing signs of spindly growth or decay from disease.

This saves carting useless tubers on to the paddock, where they are liable further to spread the cause or causes of their decay. In cases where seed has been stored in bags or pits, attention and overhaul is much more necessary than where the seed has been stored in standard boxes. This is a very important routine operation which should receive immediate attention. Every effort should be made to prevent tubers from over-sprouting, with a consequent weakening of the seed and an increasing liability of damage to the sprouts. To prevent this over-sprouting, pits should be opened up and their contents turned over.

Seed correctly sprouted and greened.

Excessive sprouting due to lack of ventilation and light.

While this is being done, opportunity should be taken to remove all tubers which are showing any sign of decay whatever. There are sure to be some which have been pitted in a damaged condition, and a varying percentage of tubers in which bacterial rot has made headway since they were placed in this storage.

After sorting over and eliminating disease-affected tubers, it is advisable that the contents of the pits be spread out at a depth of not more than about 4 inches, preferably under trees. If this be done, any tender white shoots that are showing will be hardened off by the action of the light. The same agency will green and toughen them. By this means they will be rendered fit to withstand the handling incidental to planting without sustaining much damage. Another beneficial effect of opening up the contents of the pits and spreading them out is that excessive growth of the sprouts will be checked.

It is important that the original sprouts on the tubers be kept intact so far as possible. If these be damaged or broken off the seed is considerably weakened and its value much reduced. Even though the shoots be broken off, in the majority of cases they will grow again, but the subsequent growths will be very much less vigorous than that from the original bud.

Where seed has been stored in bags, excessive sprouting can be prevented by turning the bags upside down at first, and reversing the standing position of the bags about every week or ten days. While this periodic inversion of the

bags will tend to check the growth of the sprouts, there will be considerable damage done to the young sprouts, many of which will suffer bruising or breaking. Because of this, it would be much better if seed which has been stored in bags were subjected to the same treatment as that already recommended for seed potatoes which have been stored in pits, that is, they should be opened right up, overhauled, and spread out to the light and air until such time as they are required for planting.

It would be difficult to estimate the annual loss to the potato-growers of Australia through faulty storage of seed, but it must run into thousands of tons in the aggregate. The greater part of this loss could be obviated by the use of the proper seed potato-boxes. These storage-boxes, or trays, are now standardized here, and are so well known as to make their description unnecessary. Since I first introduced them into Victoria a large number of the growers in the more important potato-growing districts of Victoria have adopted them for use, and they are becoming increasingly popular. It is safe to predict that before many years the growers of consequence who do not practise this well proved and highly economical system of potato seed storage will be the exception rather than the rule.

Dipping of seed is a most advisable operation which can be attended to any time now if it has not been done already. During the past few years the fungus disease Rhizoctonia or Collar Stem rot has made considerable headway and caused enormous damage to potato-crops. While this disease is prevalent, fortunately, it is one of the simplest and easiest to control. The control consists of dipping all potatoes intended for seed in a solution made from formalin and water. This may be done any time during the storage period between harvesting and planting. The proportion advised is 1 lb. of formalin to 20 gallons of water, and the period of immersion should be 1½ hours. This strength is advised for unsprouted potatoes; for sprouted tubers the strength of the solution should be reduced to 1 lb. formalin to 30 gallons of water, the time of immersion being the same. Corrosive sublimate or mercuric chloride also is a most effective dip, but being highly poisonous its use is not generally advocated. The solution of mercuric chloride is odourless, colourless, and practically tasteless—hence its danger. The formalin treatment is quite effective in Rhizoctonia control, and can be practised without danger. It is also inexpensive and easy to use. In one recent test the dipping of seed resulted in an increase in yield of no less than 3 tons 10 cwt. per acre over the untreated seed. Dipping is strongly advised and in all cases.

Care should be taken to have orders for manure placed with agents in ample time, so that delivery can be made early. A variation in weather conditions may render it advisable to plant earlier than usual, and because of this it is well to have the manure on hand in good time.

Only general advice can be given here as regards manures and the rate per acre at which they should be applied. For the late districts in Gippsland and Beach Forest, in which planting will commence late in the season, 6 cwt. of superphosphate and 1 cwt. of sulphate of ammonia can be allowed for. Late central districts, which embrace the red volcanic belt and the Western district west of Warrnambool (excepting Portland), do not require anything more than 3 cwt. of superphosphate and 1 cwt. ammonium sulphate per acre. Warragul is the only exception to these manurings. Warragul soils respond best to 6 cwt. superphosphate and 1 cwt. sulphate of potash per acre.

Diseases of Poultry

Nutritional and Infectious Ailments

By R. N. Johnstone, B.V.Sc., Senior Veterinary Officer.

WHEN poultry were kept mainly in small numbers on farms, outbreaks of disease were comparatively rare, and, because of the small size of the flock, were not of very great importance when they did occur. In those days hygienic considerations were not so necessary, because, as a rule, the fowls had a wide run, and picked up food in sufficient variety and quantity to keep them healthy.

On the modern poultry-farm, where large flocks are kept on small areas, the opportunities for spread of disease are much increased, the difficulties of housing and feeding are much greater, and close attention to hygiene is essential if the birds are to be kept healthy.

While it is not intended to enter into a discussion on the best type of poultry-house,* the influence of housing on the question of disease cannot be ignored. Proper ventilation is essential to health; draughty, cold houses play a great part in the development of certain forms of roup. An adequate supply of sunlight is essential to healthy fowls, and this should be kept in mind when houses are being designed. The kind of food used has a considerable effect on the health of a flock. Not only must organic nutrients be provided, but there must also be an adequate supply of minerals and nutrients.

Many diseases and practically all internal parasites are spread by the admixture of droppings with the food; therefore, buildings must be so constructed and feeding so managed that the danger of spread in this way will be lessened. Hoppers so arranged that the birds cannot stand in them will help considerably; and if scratch feeds are given, they should be so fed that they will be kept free from droppings.

The water supply is another means of spread of disease which must not be neglected. Cleanliness is essential. Disinfectants added to the water are valuable only for a limited period, and therefore utensils should be cleaned out daily.

Runs quickly become soiled with droppings and infected with parasites and bacteria. For this reason a rotation of pens will do much toward keeping poultry healthy.

Too much reliance should not be placed on the use of disinfectants. If in sufficient strength, these agents destroy bacteria with which they come in contact, but they do not injure worm eggs in the slightest. Worm eggs are destroyed by putrefaction; consequently, disinfection by removing the putrefactive bacteria actually tends to preserve the eggs. Disinfection is of little value unless preceded by a thorough cleaning. The removal of droppings at intervals sufficiently frequent to prevent their entry into food or water is the ideal at which to aim. Intestinal parasites will never become established in a house or yard which is cleaned every week. Occasional scrubbings will be found necessary although, in winter, dampness must be avoided. Chemical disinfectants should be applied by means of a spray. Crude carbolic acid used at 5 per cent. solution is a good disinfectant. The disinfection of water usually is carried out by adding potassium permanganate until the water becomes a slight purple colour. This drug is rapidly used up by organic matter in the water, and when the colour fades the disinfectant action is lost.

It should be remembered that infection comes from the fowls themselves, and that so long as diseased birds remain in the flock, cleanliness and disinfection will not entirely overcome the disease. Sometimes the distributors of disease appear healthy, and can be discovered only by a diagnostic test. Accurate diagnosis must always precede treatment. As a rule, poultry-farmers depend too much on remedies and too little on diagnosis.

Plans of poultry houses are contained in book "Poultry Industry in Victoria" obtainable from Department of Agriculture, price 2s. 9d. (posted).

The Veterinary Research Institute, Story-street, Parkville, maintains a diagnostic service which is available to all poultry-farmers of the State. Particulars of this service may be secured by direct application to the Director of the Institute, or to the Chief Veterinary Officer, Department of Agriculture.

Individual birds are seldom worth treatment, and many poultrymen follow the practice of destroying and burning all diseased birds in the belief that a sick bird is a menace to the flock. If individuals are to be treated they should be isolated to prevent the spread of the disease to others. Ordinarily, flock treatment is the only type that is effective. If disease appears in one pen, that pen should be isolated immediately by the removal of birds from adjoining pens to an isolated position in case the disease may have spread to them already. Persons entering the infected pen should not subsequently enter other pens without complete disinfection of boots and wearing apparel.

If in doubt as to diagnosis place a live sick bird in a box, and forward direct to the Veterinary Research Institute, Parkville.

Nutritional Diseases.

The deficiency diseases of poultry are largely of two kinds—vitamin deficiency and mineral deficiency. The only two vitamines which seem to have any importance in poultry feeding are A and D.

Vitamin A Deficiency.—Vitamin A is present in practically all green leaves, and therefore the disease occurs only in poultry not receiving green food. The symptoms are quite pronounced, and render diagnosis positive. There is first a watery discharge from the eyes and nose; this is followed by an accumulation in the eye of a greyish deposit that can be easily removed as it is not adherent to the eye. In the mouth, throat and gullet, little white raised, spherical nodules are found. These are diagnostic of the disease. The fowl loses condition, and finally gets weak, becomes paralyzed and dies.

Treatment of the disease is simple. If a supply of green stuff is not available, cod liver oil added to the ration in the proportion of 2 per cent. (2 lb. cod liver oil to 100 lb. foodstuff) will prevent the development of this disease.

Vitamin D Deficiency.—Vitamin D is present in green leaves and in cod liver oil. Direct exposure to sunlight makes the supply of vitamin D unnecessary, and the only birds affected are those kept away from sunlight. The effect of the deficiency is seen most commonly in young chickens, and is usually spoken of as leg weakness. Prevention is simple, exposure to sunlight, feeding a supply of green stuff, or the addition of 2 per cent. cod liver oil to the ration being effective.

Mineral Deficiency.

Iron, copper, and iodine are necessary for poultry, but the ordinary feeds probably contain a sufficient amount of these minerals to meet requirements. The most common deficiency is lime. There is an intimate relationship between the metabolism of lime and vitamin D, and rickets may be caused by a lack of either. Crooked breasts and misshapen bones also are evidence of lime deficiency. The laying hen requires a considerable amount of lime for egg-shell production, and it has been found advisable to make a supply available in the form of oyster shell, ground limestone or bone meal. Because an oversupply of lime is apt to retard growth, the addition of these substances to the feed is not advised. Mineral supplements should be provided separately from the mash so that fowls can take them at will.

Internal Parasites.

Two varieties of round worms are commonly found in poultry. An intestinal worm —*Ascardia Lineata*—1 to 3 inches in length, is found in front of the caecum, frequently in such numbers as to almost fill the intestine, and a caecum worm—*Heterakis Gallinae*—about ½ inch in length, may exist in enormous numbers in the caecum. These parasites are spread by droppings infested with their eggs, and strict attention to cleanliness of sheds and runs will greatly reduce their numbers.

Mass treatment of birds affected with the intestinal worm is carried out by the addition of tobacco to the food. For 100 birds, steep one pound of finely chopped tobacco stems for two hours in sufficient water to cover them. Mix the stems and the water with one-half the usual ration of ground feed. The day before treatment withhold all food, giving water only. After fasting 24 hours, feed the mash prepared, and two hours after it has been eaten, give one-fourth the usual amount of

ground food mixed with water in which Epsom salts has been dissolved at the rate of 11 oz. for each 100 birds. The treatment should be repeated ten days later.

For individual treatment, about three drops of oil of chenopodium in half a drachm of castor oil, or half a drachm of turpentine in two drachms of castor oil, are quite effective.

The treatment advised for destruction of the caecum worm in birds weighing 1½ lb. or over is a rectal injection of two drops of oil of chenopodium in one drachm of olive oil; to birds weighing three pounds or over, a double dose may be given.

Tapeworms.—There are many kinds of tapeworms infesting poultry. The species vary greatly in size, and several species may be found in one bird. They differ from roundworms in that they are jointed and flat. In young birds they are more serious than roundworms, sometimes causing death. No form of treatment is altogether satisfactory. Hall, of the United States of America, has found that powdered kamala gives the best results. He recommends the administration of 15 grains by the mouth, either in the form of a tablet or in a capsule; if these be placed in the back of the mouth birds will swallow them readily. The dosage mentioned is for mature birds. When young birds are being treated the quantity should be only one-half a full dose or even less. Kamala is fatal to weak chickens or those affected with roup.

Poultry tapeworms pass part of their life cycle in insects of various kinds, particularly the house fly; therefore, all measures tending to keep down the house fly will aid in breaking the life cycle of the tapeworm. Droppings should be collected frequently, and treated so that they will not be infested with flies. The addition of powdered borax to manure piles is an effective means of reducing the number of flies.

Infectious Diseases.

Poultry, almost from the day they are hatched, are liable to be attacked by many forms of infectious disease.

Pullorum Disease. — Large numbers of chickens under fourteen days old die of pullorum disease. Older hens which become infected or pullets which recover from the disease carry the germ in their ovaries, and eggs laid by them are infected. The acute form of the disease generally starts in the incubator through the hatching of eggs laid by a carrier hen. The disease may show itself in chicks several days old. Deaths occur on the third or fourth day, and continue until the third or fourth week after hatching. The peak period occurs from the eighth to the twelfth day, after which it subsides, and a certain, usually small, percentage of chicks survive.

The symptoms are not diagnostic, but consist of dullness, weakness, loss of appetite, and sometimes a white diarrhoea. Death may take place within a few hours of symptoms occurring; in some cases it may not be for several days. There are no post-mortem lesions typical of this disease. For this reason, wherever the disease is suspected, a sick bird should be forwarded at once to the Veterinary Research Institute for bacteriological examination.

A great variety of dietetic and medicinal treatments have been suggested, but on critical tests all have failed in their purpose. The only certain means of keeping poultry flocks clear of this disease is to incubate eggs only from hens known to be free from infection. The disease in mature birds may be diagnosed by a blood test, thousands of which are carried out at the Veterinary Research Institute each year. Indeed, it would be no exaggeration to say that many poultry-farmers in Victoria would have been ruined by pullorum disease but for the advice received from the Research Institute. Full particulars of the methods used in collecting and forwarding blood are contained in an article on this disease by Dr. Albiston, published in this *Journal* for April, 1930.

Fowl Pox. — Recent investigations have shown that several abnormal conditions of poultry which originally were thought to be separate diseases are really the varying symptoms of one complaint; and, therefore, those diseases known as roup, chicken pox, avian diphtheria, contagious epithelomia, and infectious coryza are now all grouped under the one term "fowl pox." A complete description of the cause, symptoms, treatment, and methods of control, written by Dr. Albiston, appeared in the August, 1930, number of this *Journal*.

Coccidiosis. — Another disease known as coccidiosis caused by one of the lowest forms of animal life, and affecting particularly young birds from two weeks on, was fully described by Dr. Albiston in this *Journal* for May, 1930.

Production of the Best Cream

Extreme Care Essential

By R. W. York, Dairy Supervisor.

ACTING as a connecting link between milk and cream suppliers and the butter factory manager, and as adviser to those whose supplies have been found to be "off quality," are two of the most important duties of the dairy supervisor. Many cases have come under the writer's notice where cream has had to be "graded down," and where the reason for its deterioration has been hard to find.

A consistently good article cannot be produced without a certain effort and vigilance on the part of all parties concerned. If the grader is lax, he is encouraging careless methods on the farm, and is working against the interests of the industry. If the factory manager is not open and candid with the supervisor concerning "graded" suppliers, he partially nullifies the supervisor's usefulness in the district, and if the supplier whose cream is "graded down" simply abuses the grader and makes no effort to assist the visiting supervisor (whose sole object is to help him) to discover the reason why his cream is of poor quality, little good will result.

The following are a few actual experiences of the writer:—

A supplier, whose premises were consistently clean and well kept, and whose methods were better than those of the average, was receiving "choice" grade only intermittently; sometimes his supplies were set down as first grade or may be second grade, and then may be in a few days they would be declared to be "choice." Though the cream delivered daily at the factory always seemed in good condition, it was at times so inferior that if kept for 24 hours, or perhaps even only 12 hours, it would putrify. Varied advice was given to the supplier from several sources, and as far as he could he acted on it, but without avail. Finally, the cream was "plated" in the laboratory at the factory and studied under the microscope, and a great number of groups of bacilli were revealed. Samples of water were obtained from each of the three galvanized iron tanks which constituted the water supply for the dairy; analysis in the laboratory proved that, whilst the water in two of the tanks was quite pure bacterially, similar bacilli to those in the cream were present in the third tank. Thenceforth the impure water, which to the eye looked faultless, was not used, and there was no further trouble.

The question arose as to why the water in one tank out of three standing side by side should be impure? The reason was that it came from an entirely separate catchment from that of the other two. The tanks containing pure water were covered, and were filled from the galvanized iron roofs of the dairy and a barn; whilst the germ-infested tank was open at the top, and was filled from the roof of the cowshed and implement-shed which was overhung by an old pine tree used by sparrows as a roosting place. Portion of the roof was white with bird droppings, and the spouting round the shed was partly full of rotten pine needles, and the trouble may have been accentuated by dust blown direct from the cowyard or washed down from the roof.

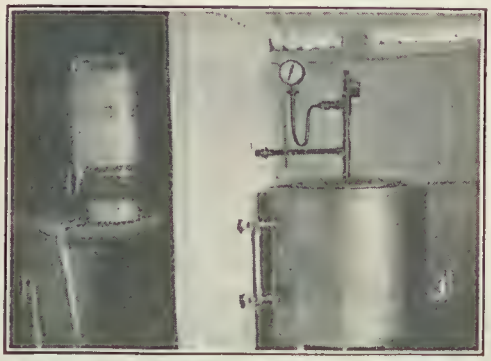
Another supplier's cream developed a faint musty, mouldy smell, with the result that it was graded "first" instead of "choice" grade. The cream when "plated" showed distinct yeast and mould growths. An inspection of the farm revealed that the premises were by no means badly kept. The owner was candid, and explained his ordinary cleansing methods in detail. The practice was to boil water in a copper morning and evening, and thoroughly scald all utensils. Two very doubtful practices, however, were followed: one, that of using "bore" water, heated in the copper, to raise the temperature of the milk prior to separating; and, secondly, the flushings from the cream spout at the close of separating were added to the bulk milk at the next separating. These two practices were stopped, and the detached separator room

and cream storage (including all racks therein) were thoroughly scrubbed with strong lime water. The result was that cream of uniform choice quality was sent from the farm daily.

A new supplier, after supplying cream to a factory for a fortnight, approached the writer and in disgust stated that, although he had done everything possible to produce a good article, he had not received a single "choicest" ticket. An inspection of the premises proved that they were spic and span, and the utensils in good order and clean. After some time had been spent looking in likely and unlikely places for the cause of the trouble, and following different clues without success, a small tin of ointment was sighted on the top wall plate of the cowshed. It was learned that two cows in a herd of seventeen were suffering from sore teats, and the ointment, a patent mixture, smelling strongly of carbolic, was being used on them. The ointment was discarded, and thereafter the cream was graded consistently "choice."

In another instance, towards the late summer, a supplier was "graded," the reason given being that his cream was "tainted." The condition of the premises and the methods followed were satisfactory, and the owner was of opinion that prickly mimosa scrub in the paddock might be to blame. Small clumps were dotted about, and the cows had frequently been seen eating the tender branches. The mimosa was all cut down, but the taint in the cream remained. Some ten days or a fortnight later, the cause of the trouble was revealed when it was found that the quality of the cream became normal with the drying up of a small stagnant water hole at which some of the cows drank.

A further instance is worth recording. In this case, for want of a more apt definition, the grader's verdict was "fishy flavour." This was known to be associated with the presence of bacteria in the milking or separating plant which caused the cream to develop, after 24 to 48 hours, an offensive and very definite "fishy" flavour. The trouble is by no means rare and is most baffling, because in many cases it occurs on farms where the methods appear to be satisfactory. Usually it is cleared up by an extra spring cleaning, and an actual "boil up" in the copper of all the utensils. In the instance under notice the plant was thoroughly cleansed, but the marked "fishy flavour" persisted. The supplier, with firm confidence in the grader's decision, and



A Sterilizing Plant at Mr. W. H. Clingin's, Bostock's Creek.

anxious to overcome the trouble, followed in every detail the advice given him. One day it was noticed that the bristles of the scrubbing brush regularly used for washing up smelt stale and sour. This brush, which was the only part of the outfit not included in the "boil up," was thoroughly cleansed and sterilized, and the offensive flavour in the cream immediately disappeared, and thereafter it was graded "choicest" with a safe margin.

In another case a tinsmith, in five minutes, by applying his soldering iron to a rusty spot on a separator float, and to a rusty corner in a milk strainer, removed the cause of a very definite "fishy flavour" in supplies; this was after a despairing dairyman had "spring cleaned" and scrubbed in vain. An ideal breeding ground for bacteria had been removed.

Trouble from an unusual source was revealed where a supplier in a big way, on whose farm milking was done by hand, and where there were several milkers, was being regularly "graded." From the day that one lad, a particularly wet and sloppy milker, signed off, the quality of the cream rose to "choice." The reason was obvious, as no other alterations had been made in the ordinary daily routine.

It is possible that these instances, in all of which the grader's decision was justified, may, to a certain degree, help to stimulate confidence in the grader. Too often suppliers whose cream is "graded down" are ever ready to affirm that the product is of the best, and abuse the grader instead of seeking the cause of the cream's inferiority.

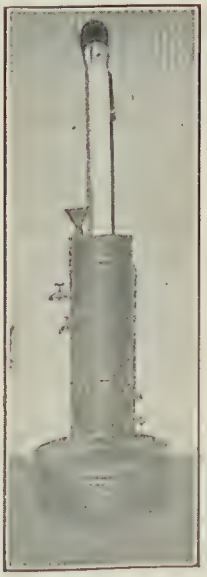
With careful dairy sanitation, there is no good reason why choice cream cannot be supplied, provided a herd is in normal health, and

has not had recent access to strongly-tainted fodder or to bad water. Deterioration is liable to occur from the time the milk leaves the cow until the finished article is consumed. The dairyman personally is responsible until the milk or cream reaches the factory and passes the grader, after which the various lots are bulked and lose their individuality. From this stage forward is another phase of the industry, but no satisfactory result is attainable unless the individual suppliers of cream have done their part; if top quality butter is to be made, the factory must have top quality cream.

To keep milk and cream as cool as possible, and guard against the inevitable decline in purity brought about by their coming into contact with foul odours, dust, and unsterilized, germ-laden or rusty utensils, should be the aim of all dairymen. An elementary knowledge of bacteriology is, of course, very desirable, but success depends entirely upon the use of the scrubing brush, cold water, hot water, boiling water or steam, washing soda, and caustic soda used in the correct place and order.

The grader's decision is by no means always cast to the detriment of the happy-go-lucky and careless dairyman. Trouble may develop in the milking machine or separator of the most careful. Mould growths in a hidden corner may be a greater cause of deterioration than some most obvious neglect. Thus it is not, as some think, a matter to hide and be ashamed of when one's cream suddenly falls to a "first grade." If any one doubts the grader's award he should, without delay, appeal to the factory manager, who will be able to place the off quality article side by side with the bulk "choice" on hand and demonstrate the difference. Once the supplier is satisfied that his article is faulty, he should immediately set to work in a systematic manner to remove the cause and, if necessary, seek the assistance of the local supervisor. Even if all "first" and "second grades" could be raised to "choice" standard there would still be the "borderline supplier," or the "choice" cream that is barely "choice."

The Bacteriologist studying Cream at Cobden Butter Factory.



An effective and economical Dairy Heater.

At this point a word may be said concerning the whole-milk supplier—the farmer who delivers his milk at the factory or creamery each morning about 8 or 9 o'clock. The morning's milk is fresh from the cow, and the previous evening's milk only about fifteen hours' old, and if bacterially contaminated in the production is, on account of its freshness (particularly in cool weather) more likely to deceive the grader than is a consignment of cream from 48 to 72 hours' old. Therefore, continuous effort on the part of the whole-milk supplier is of vital importance to the industry.

Suppliers can be divided into four definite groups. Group (1) consists of a comparatively small number of ultra-careful people,

who go almost to extremes in both their household and dairy methods. This extreme carefulness is natural to them, and they are to be commended for their consistently high quality produce. Group (2) embraces the majority of dairymen—good, honest, reliable suppliers —who can reasonably claim their share of credit for the existing standard of quality. Group (3) is made up of "graded" suppliers, who bear a monetary loss for their neglect, and through being well recognized, are isolated, and thus do not jeopardize the quality of the supply of groups 1 and 2. In group (4) are the "borderliners," the "barely choice" suppliers—those who leave so much to chance. These are the dairymen who are a real menace to the industry.

Cream awarded from 92 to 100 points represents "choice grade"; from 90 to 91 "first grade"; while that allotted from 84 to 89 is classed as "second grade," and the price of butter-fat is fixed on a sliding scale according to grade. Where a supplier sends in cream receiving only 92 points (and it is frequently done), it is graded "choice," and commands top price; but there is no margin for deterioration during manufacture, storage, and transit. If it deserves just the bare 92 points when, say, only 24 hours' old, it certainly will not produce the choicest butter if it is not blended with some of the excellent cream of group (1), or the average quality of group (2). The overseas consumer, after all, is partly the dairyman's judge. If the Kangaroo brand is not up to the mark he will ask for butter of some other brand.

It is the cream grader's duty to isolate and penalize all defective cream, and it is the moral and financial responsibiilty of all suppliers to keep the quality of their supplies as high as possible.

Summarized, the dairyman's ideal should be at all times:—

To milk healthy cows, in a cleanly manner, in cleanly surroundings.

To place the milk from the moment it leaves the cow, and later the cream, in seamless, well-tinned utensils free from rust, which have been thoroughly cleansed and sterilized.

To cool cream direct from the separator to as low a temperature as possible.

To store cream in a clean, cool, well-ventilated place, protected from vermin, dust, flies, and appreciable odours.

To refrain from mixing warm cream with cold. The reason for this is that the casual agent of destruction in cream—bacteria—thrives and multiplies in warm temperatures; if the cream be kept cool, the bacteria will remain more or less dormant, and will not have the same ill effect.

To stir cream frequently with an approved plunger of well-tinned metal (not an old axe handle or piece of candle box), thus mixing the fresh cream on top with the stale cream below. This makes for uniformity in ripening.

Lastly, to market the cream as soon as practicable after production.

Cowshed at Mr. Clingin's, Bostock's Creek.

Any dairyman who does less than follow these precautions (even though he succeeds in obtaining "choice" for his cream) is not being fair to himself and his fellow dairymen, and is depending unwittingly on some one else with a superior article, which when bulked will lose some of its value to that which is inferior. If possible, utensils should be cleaned by steam under pressure instead of hot or even boiling water. They should be first rinsed in tepid (or just warm) water so as to remove the milk, then washed with a stiff brush in hot water and washing soda to free them from all greasiness prior to scalding. If boiling water is poured over a milky vessel, the albumen in the milk will be cooked on the utensil, and cause a dull rough, false surface, which sets firm, and is a real menace in future use.

Seeing that the casual agents of destruction in milk and cream are living micro-organisms of varying types, it is only logical that these organisms must be fought at all times, and the only practical way to eliminate them from milking machines and utensils generally is by a process of heat. Hot water may not be

(*Continued on page* 391.)

Rust Disease in Boronia

By D. B. Adam, B.Agr.Sc. Vegetable Pathologist.

FEW Australian plants combine an elegance, an ease of culture with a beauty and fragrance of flower that makes their growing on a commercial scale possible. The perennial sweet-scented boronia (*Boronia megastigma*) is one of the select few. The occurrence of a disease in these plants seriously affecting their production is therefore a matter of some importance.

Although it is only during the last few years that the disease has attracted notice among commercial growers, the fungus was observed on cultivated boronia more than twelve years ago by Mr. French, jun. This appears to have been the first occasion on which rust was observed on *Boronia megastigma* Nees.

The disease is most evident in autumn when the leaves and young stems are more or less densely covered with dark-brown to cinnamon-coloured pustules which some growers have confused with the bodies of scale insects. Leaves of all stages of development may be attacked, a proportion so severely that they fall off. Young leaves are particularly liable to attack. The sustained defoliation ultimately affects the health of the larger branches which commence to die back from their tips. Within twelve months a susceptible bush may become so weakened by the disease that it no longer yields a commercially valuable quantity of flowers. Unfortunately, severe pruning does not seem to re-invest the plants with sufficient vigour to bring them back to profit.

In 1903 Dr. Hennings[1] described a rust *Puccinia boroniae* n. sp., which occurred on *Boronia spinescens* Benth. collected by Dr. Diels at Avon, Western Australia. We have compared specimens named by Hennings with the Victorian fungus, and found that in respect to microscopic characters the fungi are indistinguishable. The differences between the two consist in the fact that they occurred on different species of boronia, and that the local fungus occurred less commonly on the small twiggy branches than did the type fungus. Despite these differences, we believe that the same species of fungus is concerned in both cases, and accordingly propose that the rust on *B. megastigma* Nees be called *Puccinia boroniae* Henn.

(1) Hennings, P. *Hedwigia* XLII., p. 73, 1903.

Commercial growers when they first came to raise boronia plants in the large numbers required for their purposes found that plants from seed varied a great deal in the characters desired. Some plants flowered early; others very late; some had larger flowers than others, and so on. A patch set out with seedling boronia was very uneven; a condition with obvious drawbacks for the commercial flower-grower. The difficulty, however, was overcome by the simple means of propagating future requirements by slips or cuttings. The individuals so obtained are quite uniform, and since only the best types need be raised, the picking and general handling of the crop is greatly facilitated.

The occurrence of rust has shown that boronia plants raised from seed differ markedly from one another in still one other respect, i.e., in susceptibility to rust. Indeed, some individuals, under field conditions favorable to disease development, apparently are immune. This good fortune is added to by the fact that there are individuals maturing both early and late which combine this quality with the production of large and abundant flowers.

These facts are of the utmost importance to boronia-growers, especially since alternative measures of control such as spraying or dusting with the usual preparations have not yielded satisfactory results.

The application of this information is very simple. For propagation purposes, a grower must select his material from a bush which not only produces large and abundant flowers, but which has also been proved to be rust-resistant. The only way to be reasonably sure of this is for the grower himself to choose cuttings directly from a patch of seedlings where rust is prevalent and with them work

(*Continued on page* 391.)

Grass Silage

Pit and Stack Methods

By F. Fincher, Dairy Supervisor.

ALTHOUGH the practice of conserving ensilage made from pasture grasses has been in use for some considerable time in New Zealand, it is a comparatively recent innovation in some of the dairying districts of Victoria. However, the practice is one likely to be carried on more extensively as the process of making the silage and its high feeding value become more generally known. A brief description of the methods adopted and an account of the success achieved by those who have already tried this means of conserving surplus growth during the spring months may be of interest to readers.

Carting in.

The storage of grass ensilage enables the dairy-farmer to carry his stock through the lean period of the winter when the growth of grasses is more or less dormant. As weather conditions do not affect the making of the ensilage this form of conservation has a distinct advantage over the making of meadow hay. In many of the coastal districts the heavy rains during the spring and early summer often seriously hinder the making of meadow hay, whereas the work of making silage can be carried on almost regardless of the weather. Again, grass silage has the important advantage that it retains the natural succulence of the plants. The usual method of making grass silage is in pits or stacks. Very satisfactory results with pit ensilage have been obtained by Mr. E. Le Noury, of Werribee. On this farm two circular pits are in use, each about 10 feet in diameter by 9 feet deep. Cutting and filling was started early in October or November. The pasture consisted of cocksfoot, clovers, lucerne, and some cape weed. This was cut with the mower, cutting only sufficient for a day's carting between milkings—usually about two hours' mowing. This operation was repeated daily until the silage was from 5 to 6 feet above the surface of the pit. During the filling care was taken to see that the silage was evenly distributed in the pit, the centre being kept high. When carting was completed about 12 inches of soil was thrown on top of the material, which gradually settled to nearly ground level.

A stack in process of erection.

When opened the silage in these pits was of good quality with the exception of a patch in one pit, where excessive moisture had gathered before completion and mould had formed. The pasture made a better quality silage than the lucerne, stock ate it readily, and very little was wasted.

In the Trafalgar district stack ensilage is being tried out by several farmers, and on two adjoining farms, those of Mr. R. L. Brock and Mrs. Paine, stacks of grass ensilage were

successfully made last spring. In both cases the owners were quite satisfied as to the value of the silage for milk production. Mr. Broch stated that there was a drop of nearly 7½ gallons in the milk produced from 28 cows soon after the feeding of silage was finished and feeding on meadow hay resumed.

The method of making stack silage adopted at Trafalgar is as follows:—About the end of November, when the grass is at the flowering stage, the pasture, mainly subterranean clover and rye-grass, is mowed and carted straight to the site of the stack, which is built as quickly as possible. The material is spread evenly, well tramped, and kept high in the centre. When carting is finished soil is thrown on the top of the stack to a depth of about 18 inches. Bags filled with soil may be placed around the edge and the loose earth thrown in behind. This allows for the more even distribution of the weight which is necessary for the exclusion of air and prevention of mould.

When required for use the silage may be cut with a hay knife, and fed either in the bails or spread in the paddock, the cows being allowed access to it as soon as possible after spreading.

The high feeding value of grass ensilage is shown by the following analysis of a sample taken from a stack (36 yards in circumference by 8 feet high) in the Trafalgar district:—

—	As Received.		Dry Basis.		Calculated Digestive Nutrients—Dry Basis.
	%		%		%
Moisture	78·54		..		..
Ash	1·93		9·00		..
Crude Protein—					
Albumenoid ..	3·26	4·54	15·15	21·15	9·0
Amide ..	1·28		6·00		
Ether Extract ..	1·10		5·13		2·6
Crude Fibre ..	7·10		33·10		19·8
Nitrogen-free Extract ..	6·79		31·62		19·0

The nutritive ratio is approximately 1 to 5.

Production of the Best Cream

(*Continued from page* 388.)

sufficient to get rid of them all; some can be destroyed by being dipped in boiling water, but others of the more resistant types, particularly the spore-bearing ones, will be killed only if left for some little time in boiling water. Any vessel which is immersed in water long enough to absorb sufficient heat to cause its surface to dry immediately it is removed from the water may be regarded as sterilized and safe for use.

Once a utensil is sterilized, the only precautions necessary prior to re-using is that it be stored in a clean place free from dust and flies. A rinse with cold water after scalding (which is often practised) is harmful, because no ordinary cold water is free from bacteria, and the sterilization is immediately defeated. Furthermore, a cold rinse leaves drops of water clinging to the surface, which tend in time to set up rust.

Rust Disease in Boronia

(*Continued from page* 389.)

up his own stock. The second best way is to obtain cuttings from a strain that was originally secured in this way.

Some growers may not yet have had trouble with this disease, but they should note the advice given, for as with all fungus disease, this one is liable to spread. Even more than most growers, the boronia-grower has to look a long way ahead in planning his campaign for the control of disease.

Orchard and Flower Garden

By Edward E. Pescott, F.L.S.

Magnolia.

The Flower Garden.

THE seed-bed for summer flowering annuals should be prepared now. Select a sunny spot, sheltered from the wind and well drained. A very light sandy soil, with a small supply of old humus intermixed is the most suitable for a seed-bed. Deep sowing should be avoided; as a rule, it is sufficient to cover the seed with its own depth of soil. Some gardeners scatter the seed evenly over the seed-bed, and then work the soil amongst or around it with a rake or with their fingers. The surface should then be scattered over with crumbled humus such as fine leaf mould or very old weathered stable manure. Only a light layer is necessary. This gives shade and protection for the germinating seedlings, and also assists in keeping the bed moist.

Included in seeds to be sown are those of Aster, Zinnia, Geum, Amaranthus, Cosmos, Scabious, Phlox, Petunia, Ageratum, Bonfire Salvia, Celosia, Clarkia, Balsam, and Delphinium.

Lawns should receive thorough attention at this time of the year. First, they should be hand cleaned, and all perennial weeds such as dock, rib-grass, dandelion and others removed. Other weeds of a less permanent character may often be cleared away by a watering with a solution of ammonium sulphate (1 oz. to the gallon of water); it should be applied through a fine rose on the watering can. This treatment also enriches the grass. Then, if necessary, the lawn may be top-dressed lightly with a sandy soil. Buffalo grass lawns especially need such treatment in early spring, and sand is very desirable for the purpose, as this grass prefers a sandy soil.

Top-dress daphne plants with powdered wood charcoal. Later, give them some cow or sheep manure, or some very old stable manure. Top-dress Lily of the Valley, Rhododendrons, and Azaleas with cow or sheep manure. Give similar manure to all growing ferns. If ferns are grown in pots, a weak liquid manure should be given once a week to stimulate the new root production and the growth of the fronds.

Flowering shrubs should be thinned and shaped after flowering. This work must be done with care, as there are many shrubs such as Camellia, Magnolia, Rhododendron, and others that are very rarely pruned.

The Vegetable Garden.

Broad beans should be given a dressing of stable manure or a watering with liquid ammonium sulphate. If aphis appears, the plants should be sprayed with nicotine sulphate. As soon as the plants are in full flower, the growing tips should be pinched out, to check the growth and to cause the setting of the pods.

Beds should be dug over in preparation for the sowing of an early crop of French beans; and also for the setting out of early marrow, pumpkin, and cucumber plants.

(*continued on page* 397.)

The Making of Marmalade, Etc.

By Miss M. Knight, Assistant Fruit Preserving Expert.

Oranges and Orange Conserve.

VICTORIA.

CITRUS fruits can be preserved in many ways. The whole fruit may be used for making marmalade, conserve, and jelly; sweet oranges and grapefruit are excellent for preserving; or the juice may be bottled and the peel candied.

The large fruits with clean perfect skins are the best for candying and also for certain marmalades; the small but clean-skinned ones are the most suitable for conserve; the poorer grade—those that are sound but have scarred or blemished skins or perhaps are a little underripe—will do for the making of citrus jelly and for providing pectin for jelly that is being made from fruits deficient in this quality. Any sound fruits that have slightly damaged skins will do for jams in which the skins are not used, or the flesh may be crushed for summer drinks and those portions of the rind that are unblemished used for peel jam, with the help of lemon juice.

Preserving Oranges.

Here is a recipe for the bottling of oranges. Make a strong syrup by boiling ¾ lb. sugar to each pint of water, and remove any scum that may rise. Take the nice clear-skinned fruits and scrub them thoroughly clean; as any little black specks or scale, if permitted to remain, will show up much more after the skins are cooked than before, and every care should be taken to scrub them all off. Then with a sharp knife (a blunt one will mean loss of juice and rough edges) cut the oranges in slices about half an inch thick. Let the first and last slices be skin only and reject these. Put all the other slices in the pan of syrup, and simmer them till almost tender. Avoid fully cooking them, as they have to be heated again in the bottles, and if overdone in the first heating they will break up later. If put into cold syrup they will be sufficiently done by the time they reach boiling heat, but if put into boiling syrup they will require five or ten minutes simmering. When done, lift the pan off the stove, cover the fruit with a plate so as to keep it submerged in the syrup, and leave it to steep overnight. Next day the slices will be much more pliable and easy to pack nicely into the bottles. As each bottle is packed, fill it with some syrup (which should have been strained) from the pan. Put the lid on loosely, and stand the bottles

in the cold sterilizer; then bring the water to boiling heat, and keep it boiling for about three-quarters of an hour. In the meantime strain the syrup and bring it to boiling point; when the fruit is ready lift the jars out of the sterilizer and stand them on a folded wet towel; put the rubber rings in place, and overflow each jar with boiling syrup, and seal immediately.

Probably it will be a few months before the flavour of the skin is imparted through the whole fruit. They may be served in the same manner as most other preserved fruits.

Pectin.

Pectin is the jellying substance found in certain fruits only. It can be extracted and preserved for future use with fruits which contain little or none, such as pears, peaches, pineapples, and others. The inner white peel of oranges and lemons has a full measure of this pectin. It is usually the lower grades from which the extract is taken; by the lower grade is meant the slightly under-ripe misshapen fruits and those with scarred skins. The most pectin is got from fruits with very thick skins, and these are not so good for marmalade.

Before cutting the fruit, peel it as thinly as possible that is, take off the thin yellow rind only, but be careful not to leave any of the little oil glands on the inner white peel, as the oil in these is bitter, and if any of it remains the bitter flavour may predominate when the pectin extract is added to preserved fruit, jellies, &c. Pare off the white skin, leaving only the edible portion of the fruit, from which the juice may be extracted and used in various ways. For each pound of this white peel, allow two quarts of water, one teaspoon of tartaric acid, or the juice of three lemons. Let this all soak for about an hour; then boil it for an hour, and strain it. Put the white peel back into the preserving pan with another quart of water and half a teaspoonful of tartaric acid, or the juice of two lemons; after simmering it for another hour, strain the liquid, and add it to the first lot; then bring the whole to the boil again. The containers must be air-tight, and they should be sterilized while the pectin is being extracted. When sterilized lift them out of the sterilizer, stand them on a wet cloth, fill them with the extract, and seal air-tight at once whilst the liquid is still at a high temperature. The method of using pectin is this:—Boil the fruits deficient in pectin, in water (about half pint to the pound) till cooked; then strain, and measure the quantity of juice, and for each cupful allow one cup of sugar and one cup of pectin extract, and boil the mixture rapidly till it responds to the setting test.

Orange Marmalade.

Marmalade can be made from sweet oranges such as Navels, Valencias, and others, or from the bitter varieties as Seville, poorman, and from grapefruit. The sweet ones make a very nice mild marmalade, but they yield only half as much jelly as the bitter varieties. Further, their inner white peel does not boil clear; consequently the marmalade has not the attractive appearance of that made from the bitter kinds. If possible, choose fruit free of skin blemishes and with a fine texture, for the coarse thick skins will break up much more readily in the cooking than will the fine skins, and thus spoil the appearance of the marmalade.

Scrub the fruit thoroughly clean and weigh it. Then with a sharp knife cut it into quarters and slip the pulp from the skins. Put the pulp aside till next day. Then shred the peels as thinly as possible and put them into the preserving pan with water. For sweet oranges, allow 1 pint of water to each pound of fruit; for the bitter varieties, 1 quart to the pound. The peels should be soaked over night, for this softens them somewhat, and thus they do not take quite so long to cook. If desired, the bitterness can be reduced a little by changing this soaking water several times, but be sure the *measured* quantity is used when cooking. Cut up the quarters of pulp, remove the pips as well as those pieces of white core which are in the centre of the oranges; this core does not boil clear, and looks like little bits of scum when cooked. Simmer pulp and peel till cooked; this usually takes from three-quarters to one hour. Then lift the pan off the stove and measure the contents; put in an equal measure of sugar, and when this is dissolved boil the marmalade rapidly till it will set when tried; from 15 to 30 minutes boiling will be necessary. The process just outlined is the general way of making marmalade, but it can be varied quite a lot. A clearer product can be obtained by tying the pulp of the orange in a piece of muslin and removing it when adding the sugar.

Chip marmalade is much the same as this clear marmalade, but the yellow rind only is sliced or chipped. The easiest way to prepare this is to peel the oranges round in narrow strips about an inch wide, as thinly as possible. If possible, leave all inner white peel on the orange. Then take these long narrow strips and cut them into thin chips. Soak them overnight in the same quantity of water as for ordinary marmalade, that is, 1 pint to the pound for sweet oranges, and 1 quart to the pound of bitter varieties. Some may prefer to use only half of the peels, so that there will be more jelly. If this be so, cut the other half of the skins roughly, and tie them in with the pulp.

Orange Conserve.

This is made in the same way as marmalade, but the method of cutting the oranges may be varied. If very small, cut them right through, without peeling, into slices or rings about ½ inch thick, but if somewhat larger it is better to cut them into quarters, or eighths, or even smaller. Two things to remember when making the conserve are:—(1) Do not change the soaking water, or the acidity will be lost, and the flavour from the pulp also. (2) Owing to the acid in the pulp the fruit must not be soaked in an aluminium pan.

Lemon Marmalade.

This is not so frequently made as is orange marmalade. The simplest way is:—Weigh the lemons and halve them; extract the juice; then tear out those raggy tissues which are left adhering to the skin, and discard them. Cut the peels into very thin slices, and put them into the preserving pan with 1 quart of water to each pound of lemons. As lemons cook more quickly than oranges, there is no necessity to soak the fruit when it is cut up, and the marmalade may be made straight away if desired unless one wishes to get rid of some of the bitterness from the peel. It is then necessary to change the water. When cooking strain the juice, add it, and proceed as with oranges.

General Hints.

All marmalades should be stirred gently, as the shreds of peel break readily. The sugar must not be put in before the skins are quite tender. The mixture should be well skimmed during the final boiling, for if any scum settles on the particles of peel it is extremely difficult to remove afterwards. Marmalade often, though not always, is better if allowed to cool very slightly before it is put into the containers. If the mixture appears to be heavy, it is better to bottle it at once. If a sugar-boiling thermometer is used, let it register 221° F. If the oranges are dry instead of being juicy, there may be a difficulty in getting the marmalade to set. This, however, can be avoided by the addition of the strained juice of a few lemons. If the oranges are excessively sweet, the addition of lemon juice will be desirable.

Sometimes a mixture of citrus fruit is liked. It should be remembered when the varieties are mixed that the inner white peel of lemons and sweet oranges will not clear so well as that made from the bitter varieties; therefore a mixed marmalade may not be so attractive as that made from the bitter ones, though the flavour will be quite nice.

Miscellaneous Recipes.

Orange jelly.—For this purpose, a mixed variety of oranges may be used successfully. It may be made in the usual way, but one must be careful to see that the correct quantity of water is used according to the kind of oranges. (One pint for each pound of sweet oranges and 2 pints for each pound of sour or bitter fruit).

A very nice marmalade may be made from the peels only, with the help of lemons.

For grapefruit peel jam take three cups shredded peel, three lemons, 2 quarts of water, 3¼ lb. sugar. Make in the same manner as other marmalade.

For sweet orange peel jam allow two cups of shredded peel, two lemons, 1 quart of water, and 2¼ lb. sugar. Make this also in the same way as ordinary marmalade.

The Cypress Pine Girdler

(*Diadoxus erythurus* White)

By R. T. M. Pescott, M.Agr.Sc., Entomologist.

IN the northern and north-western sections of Victoria, the Murray Pine (*Callitris robusta* R.Br.) and its closely related variety, the Mallee Pine (*C. robusta* var. *microcarpa*), normally thrive in areas ranging from only a few trees to forests of several hundreds of acres. Generally, the Murray and Mallee pines are much sought after for building purposes in the country, on account of the hard, firm structure of the timber after seasoning, and also on account of the immunity of the seasoned timber to the depredation of insects, notably white ants.

In some seasons, as the result of unfavorable conditions at certain periods of the year, the trees become weakened or debilitated, and they are then more or less subject to the ravages of insect pests. Such a season has just been experienced in the Mallee areas. An abnormal rainfall during last winter caused the trees to put on a large amount of growth in the late winter and spring, which, however, could not be maintained when the hot summer weather occurred. The trees thus became very much weakened, and in many cases died out as a result. Those trees which did not die in the above manner became attacked, in a very large number of cases, by the cypress pine girdler, with the result that these trees also were destroyed.

Apart from these native trees which are usually only secondarily attacked, there are certain trees being grown in the Mallee areas which are primarily attacked by this insect. Many reports have been received by the Department of Agriculture, to the effect that cypress trees grown for hedge or ornamental purposes (e.g., *Cupressus Lambertiana*) have been attacked by this borer, and in many cases totally destroyed.

Froggatt (1) records that in the year 1885 dense pine scrub in portions of New South Wales were attacked by the cypress girdler, whilst French (2) in 1911, records the insect as attacking cypress hedges in the vicinity of Melbourne. In Western Australia this borer has been recorded on the hedge cypress, and land-owners have been strongly advised not to plant this cypress on land formerly growing the native cypress.

The Cypress Pine Girdler.

I. Larva of beetle; II. Perfect insect (male); III. Perfect insect (female); IV. Portion of cypress bored by larvæ; V. Portion of cypress showing perfect insect escaping from wood.

The cypress pine girdler has a very wide range over the southern half of Australia, and will almost certainly be found in the whole

of the area where the native cypress pines grow. It was originally described and figured in "Stoke's Voyage," by White in 1846, whilst it was again described and figured by Saunders in the Transactions of the Entomological Society in London in 1868. Since that time it has been constantly before the notice of entomologists. This beetle belongs to the family Buprestidae (Jewel beetles), of which a large number are native to Australia.

The cypress girdler is a slender, almost cylindrical beetle, measuring from one-half to two-thirds of an inch in length. When freshly captured and alive, it has a greenish yellow tint which fades into dull yellow after death. The upper surface of the thorax is brownish black with a yellow stripe down the centre; the wing covers are of a similar dark tint, with an elongated oval blotch followed by three irregularly rounded yellow spots down the centre of each wing cover. The adult insect, which emerges from the tree in the summer months, lays its eggs in crevices of the bark. As soon as these eggs hatch, the grubs commence boring into the wood of the tree, and feed there until they are fully grown. The most serious damage is done to the sapwood, the inner heart wood seldom being attacked. By their extensive tunnelling in the sapwood, they finally completely girdle the tree, "ringing" it, with its consequent death. The larva when fully grown measures about ½ inch in length, and is typically flattened in form, white in colour, with a small flattened pale brownish head, and tapering from the head end to the tail end. The larvae pupate in the tunnels in the tree, where they may remain for some considerable time before emerging as the adult beetle.

Control Measures.

The main method of treatment consists in the non-planting of susceptible cypress trees in the regions where the Murray Pine and closely related species grow. Very little actual control can be recommended once a tree has become affected, because of the difficulty of reaching the larvae inside the tree.

In cases where only a few holes are to be found in a tree, the larvae inside can be destroyed by inserting in the tunnels a rag dipped in carbon bisulphide, and then plugging the tunnels over with clay or soap to prevent the escape of the gas. A tree or a portion of a tree that is badly affected should be removed, and where possible destroyed by fire at once. Trees in the immediate vicinity, if economically possible, should have the lower 4 or 5 feet of trunk sprayed with kerosene emulsion, tar water, or some other deterrent with a view to preventing the beetles depositing their eggs in the bark of the tree.

References.

1. Froggatt, W. W., Forest Insects of Australia, 1923.
2. French C., Handbook of the Destructive Insects of Victoria, Part V., 1911.

Orchard and Flower Garden

(*Continued from page 392*)

A few tomato plants may be set out for the first crop; and lettuce seed may be sown in rows, in a sunny spot in the garden.

The Orchard.

Scale insects are more readily dealt with if sprayed before the tree comes into foliage. With the problem of San José scale at present with us, the trees should be searched for signs of this trouble; and if any suspicious symptoms are noted, the trees should receive an oil spray or one of lime sulphur. All prunings and cuttings should be burned.

In many orchards, growers will have a percentage of weak or unproductive trees. These should be worked on, either by budding or grafting, so that the loss of fruit will be reduced. Sometimes it is more profitable to take out the trees and replant with young ones. If this be done new soil should be used in the replanting.

Professional Papers

[This section is devoted to professional papers and articles of a scientific character.]

Endosperm Characters in Wheat

Investigations with Free Gallipoli, 1928-1931

—PART III.—

By Alan R. Raw, M.Agr.Sc., Cereal Geneticist.

[*The first portions of this paper appeared in the May and June issues of this Journal.*]

Factors Affecting Endosperm Characters.

Internal Factors—(*a*) *Position in the Ear.*—Numerous workers have indicated that the position in which the grain is borne in the ear and in the spikelet itself is one of the chief factors affecting the character of the endosperm. In order to determine the extent to which this was applicable to the variety Free Gallipoli, a number of ears was obtained from Rutherglen in 1929, and subjected to a close examination. The results obtained (Table XII.) indicated that the position in which the grain was borne in the ear had a marked effect on the character of the endosperm, and in consequence of this a more thorough investigation of the problem was carried out in 1930.

TABLE XII.—POSITION OF GRAIN IN EAR.

Spikelets.		Percentage Translucent Grains.
		%
Base	1–6	75·92
	7–10	90·00
	11–14	94·34
	15–18	93·02
Apex	19–22	88·57

Investigations in 1929 in regard to the effect of the position of the grain in the actual spikelet on the endosperm indicated that in the case of the Rutherglen material 98.6 per cent. of the grains from the lower flowers of the spikelet were of a translucent nature, while only 60.3 per cent. of those from the upper flowers were of this type. Of the total opaque types found, 79.3 per cent. occurred in upper flowers.

The investigations carried out in 1930, when Rutherglen material was again used, yielded even more striking results, and furnished definite evidence in support of the 1929 findings. Grain samples from the different spikelet groups were analysed for total nitrogen content, and the weight per 1,000 grains of each type was determined. The results (Table XIII.) indicated that the majority of grains borne in the central spikelets of the ear tend to be characterized by endosperm of a translucent nature. On the other hand, the greatest concentration of opaque type occurs in the basal and apical spikelets.

TABLE XIII.—POSITION OF GRAIN IN THE EAR.

Spikelets.		Percentage Translucent Grains.	Total Nitrogen.	Weight per 1,000 Grains.	
				Translucent.	Opaque.
		%	%	gms.	gms.
Base ..	1–4	51·00	1·85	45·40	38·40
	5–8	66·30	1·79	46·10	40·80
	9–12	72·00	1·77	50·80	39·70
	13–16	69·10	1·72	49·10	42·70
Apex ..	17–20	58·40	1·54	41·50	33·60

Total nitrogen content was found to be highest in the grains borne in the central and basal spikelets, and exhibited a steady decrease toward the apex of the ear. Further analyses showed that grains occurring in the upper flowers of the spikelet had a lower total nitrogen content than those borne in the lower flowers, the actual figures being 1.67 per cent. for grains from the upper flowers, and 1.78 per cent. for those from the lower ones.

Of the opaque types occurring in the various spikelet groups, it was found that in spikelets 1 to 4, 34.3 per cent. of the opaque grains were borne in the upper flowers. For the remaining groups the figure was—5 to 8, 62.1 per cent., 9 to 12, 56.0 per cent., 13 to 16, 26.6 per cent., and 17 to 20, 0.0 per cent., as all opaque grains occurring in this group were borne in lower flowers.

In regard to the weight per 1,000 grains, it was found that this increased from the base to the central spikelets, and then fell away again. In addition, the grains from the upper flowers of the spikelet were found to be of much lower weight than those borne in the lower flowers. These results are in accord with those obtained by Richardson and Green in 1916.

A more detailed examination in which the percentage of translucent grains occurring in each spikelet was determined furnished further evidence in support of that already obtained. The results (Table XIV.) again showed the concentration of translucent forms in the central spikelets of the ear.

It was found that 81.9 per cent. of the grains produced occurred in the lower flowers of the spikelet, and of these no less than 73.4 per cent. were characterized by endosperm of a translucent nature. Of the grains borne in upper flowers of the spikelet only 39.6 per cent. were translucent types. The results of all three examinations have indicated that the position in which the grain is borne in the ear and in the spikelet is one of the major factors influencing the character of the endosperm. The graphical representation of these results (Fig. II.) is most striking, and indicates clearly the concentration of translucent forms in the central spikelets.

TABLE XIV.—POSITION OF GRAIN IN EAR.

Spikelets. Base of Ear.	Upper Flowers.		Lower Flowers.		Total Translucent.	Total Opaque.	Total Grains.	Percentage Translucency.
	Translucent.	Opaque.	Translucent.	Opaque.				
								%
1	0	1	2	4	2	5	7	28·6
2	1	2	9	11	10	13	23	43·5
3	2	7	16	13	18	20	38	47·4
4	5	13	37	16	42	29	71	59·1
5	5	14	44	19	49	33	82	59·5
6	10	17	52	20	62	37	99	66·7
7	12	22	63	12	75	34	109	68·8
8	14	19	65	13	79	32	111	71·2
9	15	19	64	13	79	32	111	71·2
10	15	18	69	11	84	29	113	74·3
11	12	15	67	12	79	27	106	74·5
12	16	10	64	13	80	23	103	77·7
13	8	13	65	15	73	28	101	72·3
14	3	8	65	19	68	27	95	71·6
15	2	5	61	23	63	28	91	69·2
16	1	3	55	23	56	26	82	68·3
17	0	0	56	27	56	27	83	67·5
18	1	0	54	27	55	27	82	67·1
19	0	0	41	29	41	29	70	58·6
20	0	0	35	36	35	36	71	49·3
Totals =	122	186	984	356	1,106	542	1,648	Mean = 67·10% Tr.
	= 39·6% Tr.		= 73·4% Tr.					

Grains borne in lower flowers = 81·90%.

Weight per 1,000 grains—
Lower flowers = 44·75 gms.
Upper flowers = 39·75 gms.

Reviewing these results we may conclude that the endosperm characters of the grain are influenced by the position in which the grain is borne in the ear. Grains borne in the basal spikelets appear to be affected to a greater degree than those borne in the apical portions of the ear. Those occurring in the central spikelets show least variation, and are mainly of the translucent type. Such variations as do occur in these spikelets are due largely to the position which the grain occupies in the spikelet itself. The influence of the position of the grain in the individual spikelet also has a modifying effect on the character of the endosperm, grains from the upper flowers tending to be of an opaque nature. Similarly, the position in which the grain is borne in the ear and in the spikelet itself influences the total nitrogen content of the grain and its weight. The results may be briefly summarized as follows:—

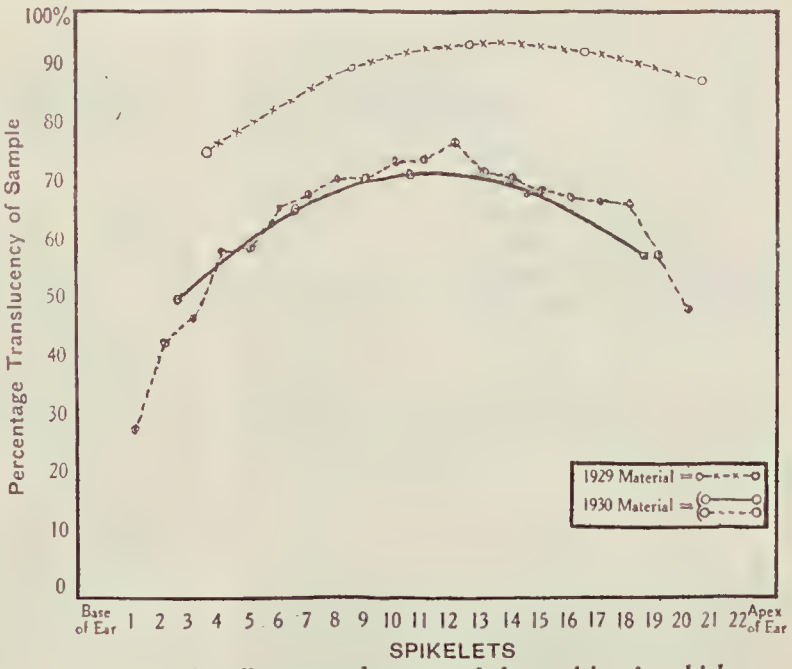


Fig. 2.—The effect on endosperm of the position in which grain is borne in the ear.

1. *Grain from basal spikelets of the ear—*
   Number of grains per spikelet low.
   Relatively low concentration of translucent types.
   Total nitrogen content high.
   Weight per 1,000 grains moderately high.
2. *Grain from central spikelets of the ear—*
   Number of grains per spikelet high.
   High concentration of translucent types.
   Total nitrogen content high.
   Weight per 1,000 grains high.
3. *Grain from apical spikelets of the ear—*
   Number of grains per spikelet relatively low.
   Relatively low concentration of translucent types.
   Total nitrogen content low.
   Weight per 1,000 grains low.
4. *Grain from basal flowers of the spikelet—*
   High concentration of translucent types.
   Total nitrogen content high.
   Weight per 1,000 grains high.
5. *Grain from upper flowers of the spikelet—*
   Low concentration of translucent types.
   Total nitrogen content relatively low.
   Weight per 1,000 grains low.

These results are in accordance with the findings of Percival and other continental workers. The differences in the percentages of translucent types obtained in the two examinations, 1928 and 1929, were due to the fact that seasonal conditions in the latter season were more conducive to slow ripening and hence resulted in a sample of grain in which the percentage of translucent types was lower than in the previous season. As stated earlier in the report, Rutherglen material was used in this series of investigations because of the fact that the grain types were most clearly defined in the samples.

External Factors—(*a*) *Season.*—Investigations conducted from 1928 to 1930 have demonstrated the tremendous influence exerted by seasonal conditions on the character of the endosperm of the grain. Grain samples from five different centres within Victoria were examined, and some striking differences in endosperm characters, as indicated by the percentage of translucent grains occurring in the sample, were recorded (Table XV.).

Samples from Carwarp in 1928-29 and 1930-31 were characterized by grain of a pure translucent nature, the typical *yellow berry* appearance being entirely absent. In each case the grains were fully developed and plump, no shrivelling being noticeable.

TABLE XV.—INFLUENCE OF SEASON ON ENDOSPERM.

Season.	Percentage Translucency of Sample.				
	Carwarp.	Salisbury.	Longerenong.	Werribee.	Rutherglen.
	%	%	%	%	%
1928–29 ..	100·00	..	100·00	98·79	36·83
1929–30 ..	..	..	..	53·28	..
1930–31 ..	100·00	56·82	55·76	29·50	23·25

Longerenong in 1928-29 also produced a pure translucent sample, but in 1930-31 the percentage translucency of the grain showed a marked decrease. On the other hand, Rutherglen in both seasons produced samples of relatively low translucency. The percentage of translucent grains in the Werribee sample was very high in 1928-29, but showed a steady decrease in the following two seasons. In 1928-29 all centres with the exception of Rutherglen experienced a very dry season, particularly during the latter part of the year, and the adverse conditions, conducive as they were to rapid ripening, were reflected in the character of the grain produced. Conditions at Rutherglen were considerably milder, and more conducive to the production of opaque types of grain. In 1930-31 the conditions prevailing at Carwarp, while not so drastic as in 1928-29, again resulted in a sample which was 100 per cent. translucent. In regard to this, it may be stated that even in the best seasons at Carwarp weather conditions during the period from flowering to maturity are conducive to rapid ripening, and hence to the production of grain having endosperm of a translucent nature, so that the factors operating might be termed climatic rather than seasonal.

Samples from Longerenong and Salisbury, which experienced milder conditions in 1930-31, were considerably less translucent than the Carwarp grain, and Werribee and Rutherglen under good seasonal conditions produced samples in which the opaque types were predominant.

The Werribee figures for the three years reflect the weather conditions prevailing during the latter portion of each season. In 1928-29, a particularly dry year, the rainfall was below normal from July onwards. However, crops made good growth until late August, when they began to show signs of lack of moisture. A dry spell in September and October, accompanied by hot northerly winds, affected them adversely, and was reflected in the character of the resulting grain, which was of a highly translucent nature. The season 1929-30 was milder, but again adverse conditions in late September and October resulted in a sample in which 53 per cent. of the grains were translucent. A very mild season was experienced in 1930-31, and though September was relatively dry, good rains and mild conditions in October, followed by cool, cloudy weather in November and December, had the effect of inducing slow ripening, thus producing an exceptionally well filled opaque sample of grain.

The figures indicate the tremendous influence exerted by seasonal conditions on the plant itself and on the character of the endosperm of the grain. It is apparent that the conditions prevailing in the latter portion of the season, particularly during the period between flowering and maturity, are of major importance in this respect. During this period the transpiration losses of the plant attain a maximum, and the strain on the organism is intense. Thus any factors tending to increase transpiration losses may be considered as being liable to cause injury to the plant, resulting in its premature death, and being reflected in the character of the grain, &c., produced. In regard to yield, seasonal conditions during the flowering period appear to be one of the major factors in its determination. At Werribee this period occurs during October, and as a result of investigations a high correlation ($r = .71 \pm .06$) has been established between October rainfall and yield over the past seventeen years. For a similar period the correlation between September rainfall and yield is much lower ($r = +.41 \pm .09$), while that for late September-October is slightly in advance of this ($r = +.64 \pm .07$). On the other hand, no correlation exists between November rainfall and yield.

Generally speaking, it may be stated that dry seasonal conditions favour the production

of grains having endosperm of a translucent nature, while cool, moist conditions tend to produce opaque types.

(*b*) *Soil.*—Samples of grain produced by plants grown on three distinct soil types occurring at Werribee were studied over a period of three seasons, 1928-30. The three types differed widely in character, and may be described as follows:—

Type A.—A fairly heavy, red, clay loam, typical of the dry farming areas of the district; this type of soil has a tendency to set hard on drying out.

Type B.—A heavy grey clay, occurring in relatively low-lying patches; this type is intermediate in character between types A and C. It becomes very boggy when wet, but on drying out does not set to the same extent as type A.

Type C.—A heavy black, self-mulching type, occurring in patches, and overlying a dolomitic pug clay. When wet this type becomes very sticky, but dries out very rapidly, forming a natural mulch. Under favorable conditions the amount of vegetative growth produced on these black soils is excessive.

The percentage translucency of the grain samples from each of these soil types is shown in Table XVI.

TABLE XVI.—INFLUENCE OF SOIL ON ENDOSPERM.

Season.	Percentage Translucency of Sample.		
	Red Soil.	Grey Soil.	Black Soil.
	%	%	%
1928-29 ..	87·60	..	99·40
1929-30 ..	3·60	12·70	15·70
1930-31 ..	5·00	10·00	70·00

1930-31 Wt/1,000 grains—
Red Soil = 36·60 gms.
Grey Soil = 36·70 gms.
Black Soil = 29·70 gms.

It will be noticed that in every case the black soil produced the most translucent sample, while in the two cases recorded the grain from the grey soil was intermediate in character. These results may be taken as an indication of the rapidity with which the three soil types lose their moisture, particularly during the latter portion of the season. In the case of the soils of type C, the rate at which the soil moisture is lost is exceedingly high, and in consequence, when dry seasonal conditions prevail, plants growing on this type of soil are adversely affected, and death is premature, resulting in the formation of grain in which the endosperm is of a translucent nature. Under extreme conditions the grain may be shrivelled. The effect of these black soil types was most marked in the 1928-29 season when particularly dry conditions were experienced in the latter part of the year. During the 1930-31 season the growth on these black soils was excessive in the early part of the year, and in consequence the plants were adversely affected by a dry spell in September and early October and by the subsequent rapid drying out of the soil. This was reflected in the low grain weight and the high percentage of translucent grains occurring in the sample. On the other hand, plants grown on the red soils, where the effects of the adverse conditions in September were negatived by the capacity of the soil to retain its moisture, produced grains of low percentage translucency.

The results of these investigations demonstrate very clearly the part played by the character of the soil in which the plant is grown, in determining the character of the endosperm of the grain. Soils in which the rate of loss of soil moisture is high tend toward the production of grain characterized by endosperm of a translucent nature. On the other hand, soils which are more capable of retaining their moisture have the reverse effect. While considering the part played by the soil in determining the nature of the endosperm of the wheat grain, it must be realized that seasonal conditions are also bound up with the problem. For example, in the case of the rapid drying out of the black soils of type C, it will be understood that this is due partly to the inherent characters of the soil itself and partly to the prevailing seasonal conditions.

(*c*) *Fertilizers.*—Indications regarding the probable effect of dressings of nitrogenous fertilizers on the character of the endosperm were obtained from an examination of grain samples from the plots in the Permanent Manurial Field at Werribee in 1927 and 1928, when it was observed that applications of ½ cwt. per acre of nitrate of soda increased the percentage translucency of the sample by 5 to 6 per cent.

To determine the actual extent to which the various artificial fertilizers affected the character of the endosperm of the grain a series

of manurial trials was carried out during the seasons 1929-30 and 1930-31. The results (Tables XVII. and XVIII.) indicated that while the translucency of the sample was definitely affected by nitrogenous fertilizers, other characters, such as total nitrogen content of the grain and weight per 1,000 grains, remained unaltered, except in extreme cases, when applications of excessive amounts of fertilizers were responsible for the introduction of a series of more complex factors. In each season the series was the same, except for the fact that in 1930-31 two plots were treated in the spring with dressings of nitrate of soda, equivalent to 4 cwt. per acre. These applications were made 21 days prior to flowering.

In each case the plots were sown on the same day under ideal conditions, germination was good and even, and the growth made throughout the season was was very satisfactory. Plots receiving dressings of superphosphate were particularly noticeable, being well in advance of all others from germination to harvest. In 1929 the plants on these plots were in ear by 18th October, some five or six days in advance of those receiving dressings of the other fertilizers and of the no-manure plots. In 1930 these differences were not so noticeable, the variation in the dates of flowering being only two or three days. Little difference was apparent in the dates of ripening, but in each season the plots receiving dressings of superphosphate matured a day or two in advance of the others, while those receiving potassium were the last to ripen. This was rather unexpected, particularly in the case of the 1930-31 plots, when marked differences in the stage of maturity were observed some ten days prior to the "dead ripe" stage. At this time it was noticed that the grain from plants grown on the superphosphate plots was relatively hard and translucent, the ears were brown and the nodes were changing colour. On the other hand, grain from plots receiving nitrogen, potassium and no manure was still in the late dough stage, though that from the unmanured plots and those receiving potassium were the more advanced. In the case of the plants on the plots receiving nitrogen the chaff was still tinged with green, while the nodes were very green. Despite these differences all plots were considered fit for harvesting within three days of each other. The only other outstanding feature in the growth of the plots was observed in 1929 in the case of the plot receiving a dressing equivalent to 4 cwt. of superphosphate per acre. Plants on this plot made an excessive amount of vegetative growth in the early part of the season, but were unable to

TABLE XVII.—EFFECT OF FERTILIZERS ON THE GRAIN, 1929–30.

Treatment.			Super.	Nit. Soda.	Sulp. Amm.	Sulp. Pot.
No Manure	Translucency ..	%	52·28	55·27	51·76	55·18
	Total Nitrogen ..	%	1·61	1·67	1·62	1·74
	Weight per 1,000 grains ..		41·75	41·05	41·95	40·65
1 cwt./acre	Translucency ..	%	50·78	70·50	66·84	54·56
	Total Nitrogen ..	%	1·62	1·69	1·65	1·72
	Weight per 1,000 grains ..		41·45	39·90	41·80	42·25
2 cwt./acre	Translucency ..	%	53·60	78·37	77·75	52·14
	Total Nitrogen ..	%	1·65	1·65	1·82	1·68
	Weight per 1,000 grains ..		38·75	40·35	39·55	43·95
4 cwt./acre	Translucency ..	%	85·20	82·40	82·64	45·84
	Total Nitrogen ..	%	2·00	1·88	1·88	1·65
	Weight per 1,000 grains ..		37·25	40·25	38·50	43·30
No Manure	Translucency ..	%	50·76	52·50	52·31	51·46
	Total Nitrogen ..	%	1·78	1·75	1·68	1·67
	Weight per 1,000 grains ..		41·70	42·25	44·45	41·10
Mean and S.E. No Manure	Translucency ..	%	= 52·69	1·62	..	..
	Total Nitrogen ..	%	= 1·69	·06	..	..
	Weight per 1,000 grains ..		= 41·86	1·18	..	..

Sown, 15.5.29. Harvested, 6.1.30–9.1.30. Seed, 86 lb./acre.

withstand the adverse conditions prevailing in September and October, when a dry spell accompanied by hot northerly winds was experienced, with the result that the grain produced was shrivelled, of a translucent nature, and relatively high in total nitrogen content.

TABLE XVIII.—EFFECT OF FERTILIZERS ON THE GRAIN, 1930–31.

Treatment—Cwt./acre.	—	Mean.	S.E.	—	—	—	—	—	—	—
No Manure	Trans. %	48·04	·84	52·00	52·00	49·75	45·00	45·50	44·00	..
	Tot. N. %	1·86	·03	1·79	1·75	1·94	2·01	1·90	1·79	..
	Wt./1,000	32·90	·57	35·30	32·20	31·70	32·50	32·60	33·30	..
Super. 1 cwt.	Trans. %	47·50	2·01	47·50	N.B.—One plot only					
	Tot. N. %	2·00	·07	2·00						
	Wt./1,000	32·60	1·39	32·60						
Super. 2 cwt.	Trans. %	48·25	·78	47·50	47·75	46·75	47·00	49·25	45·75	53·75
	Tot. N. %	1·96	·03	1·93	1·93	1·92	1·88	2·00	1·97	2·07
	Wt./1,000	33·10	·56	35·00	33·50	32·30	32·60	35·50	32·00	31·00
Super. 4 cwt.	Trans. %	45·81	·98	45·25	47·50	46·25	44·25	..	..	..
	Tot. N. %	1·90	·04	2·01	1·90	1·81	1·87	..	..	..
	Wt./1,000	29·70	·63	28·80	30·00	31·20	28·60	..	..	..
Nit. Soda 1 cwt.	Trans. %	63·88	1·36	61·75	65·25	63·25	65·25	..	..	..
	Tot. N. %	1·87	·03	1·83	2·00	1·81	1·85	..	..	..
	Wt./1,000	32·70	·70	32·40	32·30	33·10	32·90	..	..	..
Nit. Soda 2 cwt.	Trans. %	65·86	1·40	67·45	65·25	65·00	65·75	..	..	..
	Tot. N. %	1·82	·03	1·84	1·88	1·81	1·75	..	..	..
	Wt./1,000	31·40	·68	30·70	32·60	32·20	29·90	..	..	..
Nit. Soda 4 cwt.	Trans. %	71·56	1·62	68·25	73·75	74·25	70·00	..	..	..
	Tot. N. %	1·85	·03	1·87	1·82	1·77	1·95	..	..	..
	Wt./1,000	29·40	·63	28·50	30·10	29·60	29·30	..	..	..
Nit. Soda 4 cwt. 21 days prior to flowering	Trans. %	74·25	2·46	76·75	71·75	..	..	..	..	..
	Tot. N. %	1·93	·05	1·96	1·89	..	..	..	..	..
	Wt./1,000	33·70	1·29	36·10	31·20	..	..	..	..	..
Sulp. Amm. 1 cwt.	Trans. %	50·81	1·08	51·00	52·50	50·00	49·75	..	..	..
	Tot. N. %	1·89	·04	1·86	1·91	1·90	1·88	..	..	..
	Wt./1,000	32·90	·70	32·10	34·70	31·60	33·20	..	..	..
Sulp. Amm. 2 cwt.	Trans. %	55·31	1·19	54·00	55·00	55·75	56·50	..	..	..
	Tot. N. %	1·82	·03	1·77	1·75	1·82	1·93	..	..	..
	Wt./1,000	32·80	·70	33·10	32·20	34·00	31·90	..	..	..
Sulp. Amm. 4 cwt.	Trans. %	64·63	1·38	68·75	62·50	64·50	62·75	..	..	..
	Tot. N. %	1·93	·04	1·92	1·94	1·96	1·91	..	..	..
	Wt./1,000	30·40	·65	29·30	32·60	27·00	32·70	..	..	..
Sulp. Pot. 1 cwt.	Trans. %	40·75	·88	44·25	39·75	37·75	41·25	..	..	..
	Tot. N. %	1·71	·03	1·75	1·68	1·66	1·73	..	..	..
	Wt./1,000	30·70	·66	31·00	29·50	33·10	29·30	..	..	..
Sulp. Pot. 2 cwt.	Trans. %	39·81	·85	37·75	40·00	43·50	38·00	..	..	..
	Tot. N. %	1·80	·03	1·63	1·96	1·81	1·78	..	..	..
	Wt./1,000	32·50	·69	32·60	32·10	33·50	31·90	..	..	..
Sulp. Pot. 4 cwt.	Trans. %	33·91	·72	35·50	34·15	32·25	33·75	..	..	..
	Tot. N. %	1·80	·03	1·89	1·84	1·77	1·70	..	..	..
	Wt./1,000	31·30	·67	31·70	32·00	33·00	28·30	..	..	..

Sown, 20.6.30. Seed, 78 lb./acre. Harvested, 20–22.12.30.
Plots randomized. Four replications.
Trans. % = Percentage translucency. Tot. N. % = Total nitrogen content. Wt./1,000 = Weight per 1,000 grains.

In 1930 this excessive development in the early stages of growth was lacking, and milder seasonal conditions throughout the year enabled all plots to finish well.

In considering the indications furnished by the results obtained in the two seasons, the grain samples from the unmanured plots were taken as a basis upon which the following conclusions were formulated. The percentage of translucent grains occurring in the sample was increased by applications of nitrogenous fertilizers either at seeding or three weeks prior to flowering. Such increases occurred irrespective of whether the nitrogen was applied in the form of nitrate or sulphate. The extent of the increase was determined by the amount of fertilizer applied. Applications of superphosphate had no effect on the translucency of the grain sample produced except where seasonal conditions were unfavorable to heavy applications, when the effects were purely relative. Dressings of potassic fertilizers had the effect of decreasing the percentage of translucent grains in the sample. The accompanying graph (Fig. III.) demonstrates the effect of applications of the different fertilizers on the translucency of the resulting grain sample.

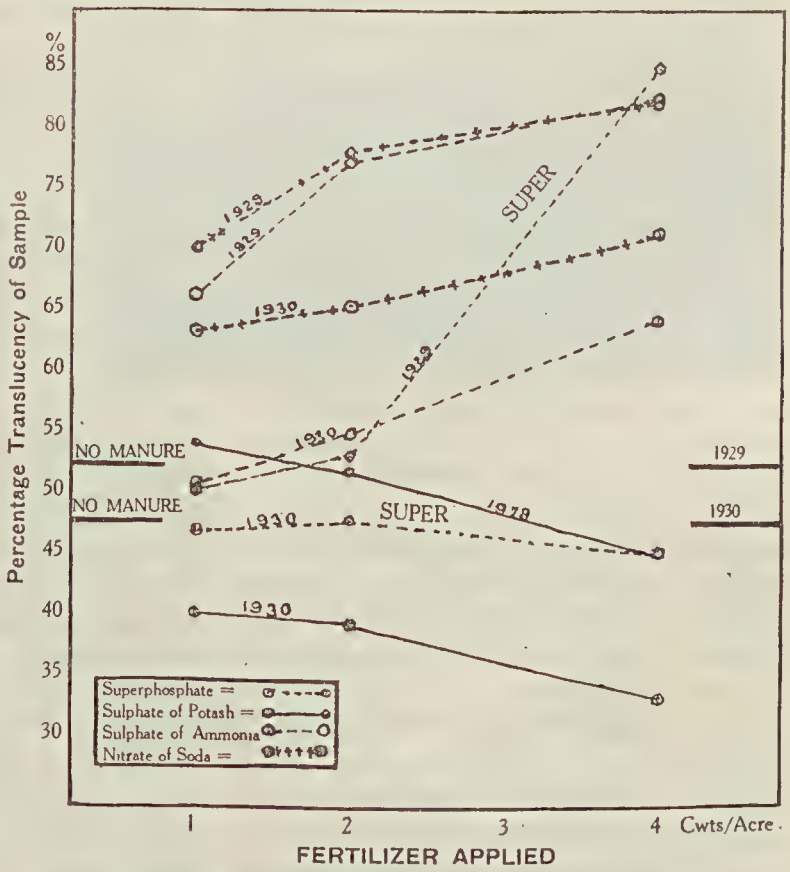


Fig. 3.—The effect of fertilisers on the translucency of the endosperm.

The total nitrogen content of the grain was unaffected by applications of nitrogenous fertilizers at seeding, but there were indications of a slight increase when 4 cwt. per acre of nitrate of soda was applied in the spring. Superphosphate had no effect on the total nitrogen content of the grain, except in the case of heavy dressings in adverse seasons, but there were indications that applications of potassic fertilizers tended to lower it.

The weight per 1,000 grains was not affected by normal dressings of nitrogen, potassium, or phosphate, but there were indications of a decrease in grain weight where excessive amounts of manure were applied, especially under adverse seasonal conditions.

There is no correlation between percentage translucency of the sample and weight per 1,000 grains or between percentage translucency and total nitrogen content, but between total nitrogen content and weight per 1,000 grains there is evidence of a negative correlation, indicating that any increases in the nitrogen content of the grain are purely relative, and are due to the under-development of the grain. The absence of correlation between percentage translucency and total nitrogen content is unexpected, and seems to point to the fact that the high degree of translucency of the samples from the plots receiving nitrogen may be of a physical rather than a chemical nature, and due possibly to the particularly rapid rate of ripening noted in the final stages of maturity.

In order to determine the actual effect of the various fertilizers, as reflected in numbers of heads per foot, size of head, &c., a census count was made on each of the plots at harvest in 1930. In reviewing the results (Table XIX.) which have brought out some striking points of difference in plants grown under different treatments, it must be realized that the figures, compiled as they are from one count at harvest, really represent the end point in the life history of the plant, and are not in any way indicative of the conditions prevailing during the early stages of its growth. Differences in population, stooling capacity, &c., were not determined, and in consequence the number of heads per foot of drill row has been taken as a basis for the investigations. Except where otherwise stated, 60 feet of drill row was observed.

In considering the results obtained, it has been deemed advisable to again use the unmanured plot as basis of comparison. Perhaps the most striking feature brought out by the results is the beneficial effects accruing from the use of superphosphate. Applications of this manure resulted in an increase in the number of heads per foot, accompanied by an increase in the size of head as indicated by the total number of spikelets per ear. The number of fertile spikelets per head was increased, but a decrease in the number of grains per fertile spikelet and in the total number of grains per head was observed. Total yield showed a large and progressive increase with increases in the manurial dressings.

Nitrate of soda applied either at seeding or in the spring had little effect. A slight increase in the number of heads per foot was apparent, but this was offset by a decrease in the number of grains per fertile spikelet and by a slight decrease in the number of grains per head, particularly in the cases where heavy dressings were applied. The total number of spikelets and the number of fertile spikelets per head were unaffected. Yield remained unalterd except in the case of heavier dressings at seeding when it was lowered.

Applications of sulphate of ammonia resulted in a slight increase in the number of heads per foot, again accompanied by a slight decrease in the number of grains per fertile spikelet and in the total number of grains per head. A slight decrease was observed also in total and fertile spikelets per head, and there were indications that dressings of 4 cwt. per acre increased the percentage of sterile spikelets corresponding to the decrease in fertile spikelets. Dressings of 2 cwt. per acre were responsible for slight increases in yield, which was otherwise unaffected.

Sulphate of potash produced a very slight increase in the number of heads per foot, but had no effect on the total number of spikelets or the number of fertile spikelets per ear. A slight decrease in the number of grains per fertile spikelet was observed, except in the case of heavy dressings, when the figure was

TABLE XIX.—EFFECT OF FERTILIZERS ON DEVELOPMENT OF PLANT.

Treatment—Cwts./acre.	Feet of Row Studied.	Heads per Foot.	Sterile Spikelets per Head.	Per cent. Sterile Spikelets.	Fertile Spikelets per Head.	Total Spikelets per Head.	Grains per Fertile Spikelet.	Grains per Head.	Total Nitrogen Content.	Weight per 1,000 Grains.	Yield per 60 Feet.
				%					%	gms.	gms.
No Manure	90	9·62	4·4	26·0	12·5	16·9	1·42	17·8	1·90	32·12	333·0
Super. 1 cwt.	30	15·00	5·0	27·0	13·5	18·5	1·22	16·9	2·00	32·58	497·0
Super. 2 cwt.	60	16·8	4·8	25·0	14·4	19·2	1·14	16·4	1·95	32·14	510·5
Super. 4 cwt.	60	20·20	5·1	26·2	14·4	19·5	1·17	16·9	1·94	28·71	588·5
Nit. Soda 1 cwt.	60	10·15	4·3	25·3	12·7	17·0	1·33	16·9	1·82	32·73	337·0
Nit. Soda 2 cwt.	60	10·70	4·1	25·2	12·2	16·3	1·26	15·4	1·83	31·43	310·5
Nit. Soda 4 cwt.	60	10·97	4·3	25·9	12·3	16·6	1·09	13·5	1·82	29·06	259·0
Nit. Soda 4 cwt. Spr. ..	60	11·20	4·4	25·4	12·9	17·3	1·11	14·3	1·93	33·63	324·0
Sulp. Amm. 1 cwt.	60	10·47	3·6	22·1	12·7	16·3	1·38	16·3	1·88	31·83	326·0
Sulp. Amm. 2 cwt.	60	10·43	4·1	25·2	12·2	16·3	1·38	17·4	1·79	33·10	361·0
Sulp. Amm. 4 cwt.	60	12·05	5·2	30·6	11·8	17·0	1·21	15·0	1·94	28·14	306·0
Sulp. Pot. 1 cwt.	60	9·73	4·0	24·1	12·6	16·6	1·22	15·1	1·71	29·36	258·5
Sulp. Pot. 2 cwt.	60	10·33	4·3	25·8	12·4	16·7	1·29	15·4	1·87	32·01	305·5
Sulp. Pot. 4 cwt.	60	10·27	4·4	26·0	12·5	16·9	1·40	17·5	1·80	29·73	321·0

unaltered. This also applies to the number of grains per head. In all cases the yield was depressed, the decrease being most marked in the case of plots receiving dressings equivalent to 1 cwt. per acre.

(d) Stage of Maturity at Harvest.—To determine the extent to which the endosperm of the grain is affected by harvesting the plant at different stages of maturity a series of plots was sown in 1929 and 1930. All plots were sown under ideal conditions on the same day. Germination was good and even, and no differences were noticeable in the development and growth of the plots throughout the season. In each season plots were harvested at random, at intervals from the beginning of December. In 1929-30 two plots were cut on each occasion, but in the following year the number was increased, four plots being harvested at intervals of five days. Accurate observations regarding prevailing weather conditions were made during the period of harvesting.

The "time of harvesting" tests.

In the case of the 1929-30 series the plants on all plots flowered between the 18th and 21st October. The first two plots were harvested on 12th December, when it was found that the ears had changed colour and that the

TABLE XX.—EFFECT OF STAGE OF MATURITY ON ENDOSPERM, 1929–30.

Date of Harvesting.	—		Mean.	S.E.	Plot A.	Plot B.
12.12.29	Translucency ..	%	92·23	2·72	88·47	95·99
	Total Nitrogen ..	%	1·71	·07	1·55	1·87
	Weight per 1,000 grains ..		40·77	1·21	41·35	40·18
17.12.29	Translucency ..	%	81·43	2·40	81·27	81·58
	Total Nitrogen ..	%	1·65	·07	1·61	1·69
	Weight per 1,000 grains ..		39·91	1·18	40·63	39·18
21.12.29	Translucency ..	%	72·93	2·14	75·32	70·54
	Total Nitrogen ..	%	1·56	·06	1·60	1·51
	Weight per 1,000 grains ..		38·72	1·15	38·80	38·63
24.12.29	Translucency ..	%	71·46	2·11	73·60	69·31
	Total Nitrogen ..	%	1·53	·06	1·48	1·58
	Weight per 1,000 grains ..		38·75	1·15	38·65	38·85
30.12.29	Translucency ..	%	61·08	1·82	66·40	55·76
	Total Nitrogen ..	%	1·64	·06	1·74	1·54
	Weight per 1,000 grains ..		39·79	1·18	36·65	42·93
6.1.30	Translucency ..	%	54·79	1·65	55·32	54·26
	Total Nitrogen ..	%	1·59	·06	1·60	1·57
	Weight per 1,000 grains ..		39·07	1·16	36·50	41·63
13.1.30	Translucency ..	%	52·93	1·56	52·96	52·89
	Total Nitrogen ..	%	1·60	·06	1·53	1·67
	Weight per 1,000 grains ..		42·42	1·24	43·18	41·65

Sown, 15.5.29. Seed, 86 lb./acre. Superphosphate, 168 lb./acre.

grain was hardening. Successive cuts were made until 13th January, 1930. In 1930-31 the flowering period occurred between 27th and 31st October. The first group of plots was harvested on 5th December, when the plants were more immature than was the case at the first cut in 1929. Observations showed that the chaff was just changing colour, while the straw was still rather green, the nodes being green and sappy. The grain was in the late dough stage, but was showing signs of hardening. By the 10th December, when the second cut was made, the grain was found to be definitely hardening, though the chaff and the nodes were still tinged with green. Five days later the grain was quite hard, and by the end of the month the plants were considered to be in a fit condition for stripping. Harvesting was continued at regular intervals until 30th January, 1931.

The results (Tables XX. and XXI.) were very similar, and indicated very strikingly the differences in translucency effected by harvesting the plants in different stages of maturity. In each case the plots harvested in the early part of December were characterized

TABL XXI.—EFFECT OF STAGE OF MATURITY ON ENDOSPERM, 1930–31.

Date of Harvesting.	——		Mean.	S.E.	Plot A.	Plot B.	Plot C.	Plot D.
5.12.30	Translucency ..	%	89·00	1·13	89·50	91·50	90·50	86·50
	Total Nitrogen ..	%	1·80	·02	1·83	2·01	1·84	1·72
	Weight per 1,000 grains ..		34·19	·61	33·00	28·73	33·43	36·13
10.12.30	Translucency ..	%	83·06	1·07	84·75	84·25	82·00	81·25
	Total Nitrogen ..	%	1·92	·02	1·92	1·95	1·83	1·96
	Weight per 1,000 grains ..		35·78	·64	35·85	34·38	38·60	34·28
15.12.30	Translucency ..	%	76·38	·98	79·00	78·25	75·50	72·75
	Total Nitrogen ..	%	1·95	·02	1·92	1·96	1·92	1·99
	Weight per 1,000 grains ..		35·62	·64	36·35	33·33	37·23	35·55
20.12.30	Translucency ..	%	67·63	·87	69·75	68·75	67·25	64·75
	Total Nitrogen ..	%	1·89	02	1·88	1·89	1·85	1·93
	Weight per 1,000 grains ..		33·50	·60	34·08	32·78	33·40	33·75
25.12.30	Translucency ..	%	64·63	·83	65·50	65·00	65·50	62·50
	Total Nitrogen ..	%	1·94	·02	1·97	1·89	1·97	1·91
	Weight per 1,000 grains ..		33·97	·61	33·73	36·15	33·65	32·35
31.12.30	Translucency ..	%	59·75	·77	59·75	62·00	58·75	58·50
	Total Nitrogen ..	%	1·95	·02	1·96	1·97	1·89	1·99
	Weight per 1,000 grains ..		32·22	·58	33·20	32·83	30·88	31·98
5.1.31	Translucency ..	%	54·69	·71	55·00	54·75	54·00	55·00
	Total Nitrogen ..	%	1·92	·02	1·89	1·98	1·96	1·84
	Weight per 1,000 grains ..		33·79	·61	35·98	34·13	31·75	33·30
10.1.31	Translucency ..	%	54·50	·70	54·50	55·50	52·50	55·50
	Total Nitrogen ..	%	1·91	·02	1·96	1·89	1·96	1·88
	Weight per 1,000 grains ..		34·98	·63	36·50	34·33	33·75	35·33
15.1.31	Translucency ..	%	53·13	·68	52·50	55·00	52·50	52·50
	Total Nitrogen ..	%	1·80	·02	1·75	1·79	1·75	1·90
	Weight per 1,000 grains ..		36·37	·65	36·58	37·55	36·03	35·30
20.1.31	Translucency ..	%	55·67	·72	54·00	59·25	54·50	58·50
	Total Nitrogen ..	%	1·91	·02	1·90	1·83	1·91	1·91
	Weight per 1,000 grains ..		34·20	·61	33·15	31·10	35·25	29·90
30.1.31	Translucency ..	%	55·50	·71	54·50	59·25	56·50	55·50
	Total Nitrogen ..	%	1·86	·02	1·89	1·85	1·83	1·85
	Weight per 1,000 grains ..		34·83	·62	34·00	30·08	34·58	35·92

Grain shrivelled, discarded in calculations.
Sown, 20.6.30. Seed, 78 lb./acre. Superphosphate, 156 lb./acre.

by the production of grain having endosperm of a highly translucent nature. As maturity proceeded the percentage of translucent grains in the sample diminished steadily until a point was reached, about the first week in January in each case, when it became constant. The extent of the decrease in each case was approximately from 90 per cent. to 54 per cent. The rate of decrease as shown in Figure IV. was comparatively even, with the exception of the period between 21st and 24th December, 1929, when weather conditions conducive to the rapid drying out of the grain prevailed.

In 1929 the weather conditions prior to the first cut were very variable, but on the whole were conducive to rapid ripening. This was particularly the case from the 8th to the 10th of the month, when hot northerly winds were experienced. Following this a period of mild, showery weather was experienced, culminating in a precipitation of 44 points of rain the day before the second cut was made, and mild conditions prevailed until the 21st of the month, when the third set of plots was harvested. The effect of these conditions was to appreciably lower the percentage of translucent grains in the sample. From 21st December temperatures rose, and, as stated above, conditions conducive to the rapid drying out of the grain prevailed, and were reflected in the check in the rate of decrease in percentage translucency of the grain, but following this cool, cloudy conditions were experienced, and 108 points of rain were recorded during the four days prior to the harvesting of the fifth set of plots. These conditions prevailed throughout the first week in January, but were followed by a marked rise in temperature, accompanied by strong northerly winds, after which cool, cloudy weather was experienced from 10th to 13th of the month when the final cut was made.

In 1930, hot conditions, accompanied by northerly winds, were experienced in the early part of December prior to harvesting the first set of plots. Following this, cool, mild conditions prevailed, and during the five days preceding the second cut 138 points of rain were precipitated. Similar weather was experienced until the 20th of the month, though the only rain of any note was a fall of 60 points on 16th. The period from the 20th to the 25th was marked by a rise in temperature, and the effects of hot northerly winds at this stage are reflected in the slowing up of the rate of decrease in the percentage translucency of the sample. Following this, warm, mild conditions, accompanied by light showers were experienced throughout the remainder of the harvesting period, the only exceptions being four days in the latter part of January, when northerly winds prevailed.

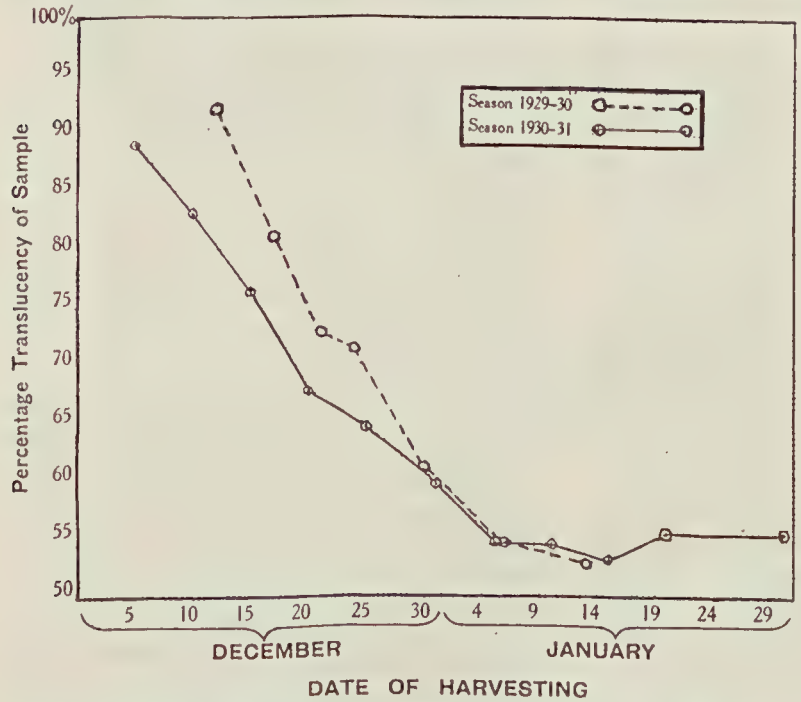


Fig. 4.—Graph showing rate of decrease in percentage translucency of grain samples harvested at various stages of maturity.

The total nitrogen content of the grain was not affected in any way when plants were harvested at different stages of maturity. Similarly the weight per 1,000 grains was not affected to any marked extent, though there were indications of a slight but steady decrease throughout, thus indicating that the grain was fully developed

before the first cut was made. Fluctuations occurring in the weight per 1,000 grains were possibly due to moisture absorption as the grain became softer and more starchy. In some cases (e.g., 2nd cut, 1930-31) precipitations of rain on the day prior to harvesting may have been responsible for slight increases in grain weight, but such conditions did not always prevail.

"Period of Ripening" tests showing methods adopted to prolong the ripening period of the plants.

No correlation was established between total nitrogen percentage and translucency, but nitrogen content and weight per 1,000 grains again showed a negative correlation. The absence of a correlation between nitrogen content and translucency seems to point to the fact that the translucency in this case is purely a physical character. Harvesting in the early stages of maturity, followed by the rapid drying out of the sample, is reflected in the translucency of the grain.

While the grain remains in the plant in the field this drying action is less drastic, and in consequence grain of a less translucent type results. Finally a stage is reached where the loss of moisture practically ceases and the translucency of the sample becomes relatively constant. It is apparently the *rate of drying* rather than the total amount that affects the character of the endosperm of the grain.

(*e*) *Conditions at Ripening.*—To determine the effect of prolonging the period of ripening of the plant on the character of the endosperm of the grain a series of plots was sown in 1929 and in 1930. In each year the plots were sown under ideal conditions, germination was good and even, and the plants made good growth throughout the season. In considering the treatment of the plots during the latter stages of growth and maturity each series will be dealt with separately.

The 1929 series comprised four plots, of which two were allowed to develop and mature under normal conditions. Of the other two, one was protected during the period from flowering to maturity by means of a windbreak, while the second was straw mulched. It was considered that such protection, by inducing milder conditions than normally apply, should extend the period of maturity of the plants, and by allowing more time for the deposition of starch result in the production of a better developed opaque type of grain. The windbreak consisted of bags carried on a wooden framework erected round the plots. The treatments were applied in late October during the flowering period of the plants. On 28th October the two protected plots were given a watering equivalent to 1 inch of rain; this was followed by a second watering of 1 inch on 6th November. The rainfall for the remainder of November was 214 points, while 208 points were registered in December and early January. The plots grown under normal conditions and that to which the straw mulch was applied showed no difference in the date of ripening, and were considered fit for harvesting on 6th January, 1930, while that protected by the windbreak matured some five days later.

In view of the failure of the attempt to prolong the ripening period by means of a straw mulch this method was discontinued in 1930, when windbreaks were used for all plots. Three plots of a series of six were protected in this manner, and one of these was completely roofed in in an effort to further prolong the period between flowering and maturity. Protections were erected on 23rd October, a few days prior to flowering, which was complete by the 31st of the month. One inch of water was applied to all protected plots on the 23rd, and in addition, the plot over which the roof had been erected was given a further watering of ¾ inches on 27th October. On 31st October the three protected plots were again watered, each receiving ¾ inches. The plants were then left to mature, but on 6th December plants on the roofed plots, which were still in a very green

TABLE XXII.—EFFECT OF PROLONGED RIPENING ON GRAIN.

Treatment.	——	1929–1930.		1930–1931.		
Normal Ripening	Translucency %	82·60	78·46	55·75	52·25	60·00
	Total Nitrogen %	1·65	1·62	2·17	2·06	2·12
	Weight per 1,000 ..	31·93	33·05	36·45	35·03	32·90
Prolonged Ripening	Translucency %	47·85	71·53	37·75	40·25	92·00
	Total Nitrogen %	1·46	1·60A	1·97	2·02	2·57B
	Weight per 1,000 ..	33·03	32·30	33·43	34·80	28·53

Plots subjected to different treatment.
Discarded in calculations. A—Straw mulched. B—Roofed.
Seed, 90 lb./acre. Superphosphate, 168 lb./acre.

condition, were again watered, the application being equivalent to 25 points of rain. The rainfall for November, December, and early January aggregated 516 points, and weather conditions during this period were generally conducive to slow ripening. The plants, maturing under normal conditions, had ripened, and were harvested on 20th December, while those in the protected areas were considered to be fit for harvesting on 29th of the month. Plants grown on the plot which had been roofed in remained green until the end of December, when the roof was removed, resulting in their rapid drying out and premature death. Plants were harvested on 6th January, 1931. The straw and chaff of these plants was bright yellow in colour, and the grain was very small and translucent, but showed no signs of shrivelling. The figures obtained from this and from the straw mulched plot in 1929 have been discarded in the calculation of results. In both seasons plants on the protected plots suffered from rather severe rust attacks, but the effect on the grain was not noticeable.

The results of these investigations (Table XXII.) showed that the character of the endosperm of the grain may be determined to a great extent by subjecting the plants to a prolonged period of maturity.

In all cases but one, plot B, there was a marked decrease in the percentage of translucent grain, accompanied by a significant decrease in the total nitrogen content of the grain, when the period of maturity was prolonged. The weight per 1,000 grains remained unaltered. The high degree of translucency of the sample from plot B, accompanied by a marked increase in total nitrogen and a decrease in weight per 1,000 grains, was due to the factors outlined above which operated during the latter stages of maturity. In the case of plot A, which was straw mulched in 1929, the period of ripening was not prolonged, but the plants received an abundant supply of water, resulting in the production of a grain sample in which the percentage translucency was slightly lowered.

The decrease in percentage translucency due to the prolonging of the period of maturity again points to the fact that it is *rate of drying out* that is responsible for the character of the endosperm. This is supported by the behaviour of plot B.

The decrease in the total nitrogen content of the grain of plants grown under conditions which prolonged the period of maturity, is probably relative, being due to the extra deposition of starch in these samples.

(*f*) *Rate of Seeding.*—To determine whether the character of the endosperm of the grain was in any way affected by the amount of seed sown per acre, or by the time at which it was sown, a number of grain samples from plots in the "Time and Rate of Seeding" tests in 1930, were examined. The results, Table XXIII., indicated that the amount of seed sown per acre had little effect on the character of the endosperm of the grain.

In the case of the grain from plots which were sown early in the season, the percentage translucency, total nitrogen content, and weight per 1,000 grains were unaffected. In the late sown series, however, the percentage translucency of the sample increased as the rate of seeding was increased, but total nitrogen content and weight per 1,000 grains were again unaltered.

(*g*) *Time of seeding.*—The results (Table XXIII.) indicate that time of seeding plays a more important role in determining the character of the endosperm of the grain than does the rate of seeding. The percentage of translucent grains occurring in the sample was definitely increased when plants were subjected to late sowing, the extent of the increase being 13 per cent. The total nitrogen content of the grain remained unaltered in the case of the lighter rates of seeding, but showed indications of a slight increase in the samples from the late sown plots, when the seeding rate rose above 90 lb. per acre. This is only a relative increase due to differences in the weight per 1,000 grains. In every case the weight per 1,000 grains was significantly lower in the samples from the late sown series. As in the case of the total nitrogen content of the grain, the difference was most marked when the seeding rate exceeded 90 lb. per acre. The increase in the percentage translucency of samples from the late sown plots, accompanied by the decrease in weight per 1,000 grains, is possibly due to the fact that, by late seeding, the growth period of the plant is curtailed, and in consequence its development is restricted.

Discussion.

From a study of the results obtained in the selection work, it is obvious that the endosperm characters, translucency and opacity, are not heritable, but are determined by a number of factors, both internal and external, which influence them to a varying degree. Of the factors influencing these endosperm characters, climatic and seasonal conditions are the most important, and the effect of these may be so marked as to mask or modify the effect of any of the other factors concerned. While the grain sample of Free Gallipoli is typically a

TABLE XXIII.—EFFECT OF TIME AND RATE OF SEEDING.

Rate of Seeding.	——	Early Sown.	Late Sown.
45 lb./acre	Translucency .. %	23·00	30·00
	Total Nitrogen .. %	1·67	1·67
	Weight per 1,000 grains ..	38·40	34·60
60 lb./acre	Translucency .. %	22·00	35·50
	Total Nitrogen .. %	1·69	1·68
	Weight per 1,000 grains ..	38·70	35·20
75 lb./acre	Translucency .. %	24·50	35·00
	Total Nitrogen .. %	1·68	1·68
	Weight per 1,000 grains ..	38·80	34·75
90 lb./acre	Translucency .. %	24·50	35·50
	Total Nitrogen .. %	1·69	1·71
	Weight per 1,000 grains ..	36·80	34·95
105 lb./acre	Translucency .. %	22·00	40·00
	Total Nitrogen .. %	1·61	1·65
	Weight per 1,000 grains ..	39·20	35·30
120 lb./acre	Translucency .. %	22·00	40·00
	Total Nitrogen .. %	1·61	1·77
	Weight per 1,000 grains ..	39·00	34·45

——	Translucency.		Total Nitrogen.		Weight per 1,000 Grains.	
	Mean.	S.E.	Mean.	S.E.	Mean.	S.E.
	%		%		gms.	
Early Sown	23·00	·49	1·66	·015	38·48	·38
Late Sown	36·00	1·61	1·69	·017	34·88	·13
Difference ..	13·00	1·68	·03	·023	3·60	·40

yellow berry type, it may, under particularly drastic climatic or seasonal conditions, be so modified that only grains having endosperm of a translucent nature are present. On the other hand, exceptionally mild, moist seasonal conditions may result in the production of a pure opaque sample.

It is apparent, then, that seasonal conditions are of major importance in determining the character of the endosperm, and particularly those conditions prevailing during the period between flowering and maturity. Hot, dry, conditions during this period almost inevitably result in the production of a translucent sample, due to the increase in the rate of drying out of the plant, and its premature death. Adverse seasonal conditions in the earlier stages of growth have little effect on the endosperm of the grain providing normal conditions prevail from the heading stage onwards. The influence of conditions at flowering is of undoubted importance in so far as yield is concerned. The correlation existing between rainfall at this stage and yield furnishes definite evidence in support of the critical period theory of van de Sande Bakhuyzen, Maximov, and Richardson. In addition, the correlations established between weather conditions at flowering, and the total nitrogen content of the grain, seem to suggest that translucency of endosperm may also be influenced by these conditions, but, though it is highly probable that mild conditions during the critical period would have the effect of prolonging the period of maturity, resulting in a greater deposition of starch, it is doubtful whether the character of the endosperm of the grain would be affected to any marked extent, except in exceptional cases. (Cf. Manurial Plots, 1929-30, supr. 4 cwt. per acre).

From a review of the results obtained in the "Prolonged Period of Maturity" and the "Stage of Harvesting" tests, it appears that the weather conditions prevailing in the latter stages of the period of maturity are the most important, and it is suggested that hot, dry conditions at this stage would result in the production of a grain sample of high translucency, even if the plants had been subjected to very mild conditions at the time of flowering. Though a prolonged period of ripening is accompanied by a greater deposition of starch, it is not the amount of starch formed that induces opacity, but is rather the fact that, during the final stages of maturity, mild weather conditions are essential for the extension of this period, and such conditions are conducive to slow ripening, and hence, to the production of an opaque sample. It is apparent that, in so far as the variety Free Gallipoli is concerned, the character of endosperm translucency is purely a physical phenomenon, which is induced mainly by the rate of drying out of the grain sample in the final stages of the period of maturity. There is an abundance of evidence in support of this, the most striking example being furnished by the behaviour of Plot B in the "Period of Maturity" tests in 1930-31. The presence of the minute planes of fracture in the endosperm of the translucent grains points to the fact that such types have been subjected to rapid desiccation. On the other hand, the work of Bailey and Percival has shown that the appearance of the opaque grains is due to internal fissures developed within and between the cells during the process of slow ripening.

The part played by soil in determining the character of the endosperm is largely dependent on climatic and seasonal conditions. The main factor appears to be the rate at which the soil loses its moisture. This rate of drying out reacts on the plant, and, under adverse seasonal conditions, may be responsible for the premature death of the organism, thus curtailing the period of ripening, and resulting in the production of a translucent sample.

The effect on the endosperm of the stage of maturity at which the plant is harvested is again largely dependent on the weather conditions prevailing during the latter portion of the period of maturity. Cool, moist, conditions, slowing up the rate of drying out, are conducive to the formation of grain having endosperm of an opaque nature. The characteristic translucent appearance of grain harvested in the early stages of maturity is probably due to the rapidity with which the sample dries out after the plants are harvested. The grain in the plant growing in the field loses its moisture much less rapidly than that of a plant that has been harvested. As maturity proceeds, unless conditions are particularly hot and conducive to rapid ripening, the grain loses its moisture gradually, with the result that grain samples in which the endosperm is of an opaque nature are produced. Under cool, moist conditions, if the plants are left standing in the field after they are fully mature, the grain may undergo a mellowing

process resulting in a further development of opacity in the sample. This is apparently due to moisture absorption, and in no way affects the chemical composition of the grain.

The influence of nitrogenous fertilizers on the character of the endosperm of the grain appears to be a physical rather than a chemical action, since increases in percentage translucency of the sample are not accompanied by increases in total nitrogen content. The high degree of translucency induced by these manures may possibly be due to their action in slowing up the rate of maturity until mid December, when weather conducive to rapid ripening supervenes with the result that the final rate of drying out of the sample is exceptionally high. Potassic fertilizers do not have this effect on the plant, but rather induce a slow but steady rate of ripening. On the other hand, superphosphate does not affect the character of the endosperm to any extent, except in cases where excessive amounts are applied under adverse seasonal conditions, when premature ripening results in the production of translucent samples.

The effect of late seeding, resulting in a curtailment of the growing period of the plant, and a consequent speeding up of the rate of maturity, is reflected in the translucency of the grain sample.

In regard to the total nitrogen content of the grain, it is interesting to note that none of the factors studied influenced it to any degree, and in view of this it is suggested that it is inadvisable to use characters such as the appearance of the grain as a guide to milling and baking quality. Such variations as did occur in nitrogen content were, with one or two exceptions, purely relative, and were due to decreases in the weight per 1000 grains. In the case of the plots which were subjected to a prolonged period of ripening, decreases in total nitrogen content were observed, and were probably due to greater starch formation in the grain.

Summary and Conclusions.

1. Grain samples from the variety Free Gallipoli, *T. vulgare, var. alborubrum, Korn.*, were studied, and three distinct grain types were isolated and classified according to the nature of the endosperm. Of these, Type A is characterized by endosperm of a translucent nature, while, in the case of Type B, the endosperm is soft, starchy, and opaque. The third type, C, is intermediate between types A and B, and the endosperm presents a mottled or marbled appearance. These three types constitute the condition of *yellow berry*, reported by numerous workers.

2. In any sample the translucent grains are slightly longer, 5 to 6 per cent. heavier, harder, and of higher total nitrogen content (about 15 per cent.), than the opaque. They present a flinty appearance in section in comparison with the soft, floury nature of the opaque forms. The endosperm is traversed by minute cracks, at right angles to the long axis of the grain. These are absent in the opaque types.

3. The germinating power of the two types is equal, though under field conditions the softer opaque grains appear to be more susceptible to outside influences, of which the attacks of fungi are possibly of major importance. The rate of germination is faster in the case of the opaque types, owing to the fact that they absorb moisture more readily than the translucent forms. Translucent grains retain their vitality for longer periods than do opaque forms.

4. The endosperm characters, translucency, and opacity are not heritable, but are physical phenomena which are determined by a number of factors, both internal and external, which influence them to varying extents.

5. The position in which the grain is borne in the ear, and in the spikelet, is the most important of the internal factors influencing the character of the endosperm of the grain. Grains from the central spikelets of the ear, and from the basal flowers of the spikelet, tend to be more translucent than those occurring in the basal and apical spikelets, or in the upper flowers of the spikelet.

In addition, the total nitrogen content of the grain varies with the position in which the grain is borne in the ear, and in the spikelet, being highest in grains from the basal spikelets, and from the basal flowers of the spikelet, and lowest in those occurring in the apical spikelets, and in the upper flowers. The weight per 1,000 grains reaches a maximum in the central spikelets, and falls away toward the base and the apex. Grains from the lower flowers of the spikelet are heavier than those occurring in upper flowers. The number of grains per spikelet is highest in the central spikelets of the ear, and falls away towards the base and the apex.

6. Seasonal conditions constitute the most important external factor influencing the character of the endosperm of the grain. Hot, dry

conditions conducive to rapid ripening result in the production of grain having endosperm of a highly translucent nature; cool, moist conditions tend to produce opaque types. The seasonal effects may be so drastic as to produce a sample in which all the grains are of one type, that is, either pure translucent, or pure opaque, thus modifving or masking the effect of all other factors. Weather conditions prevailing during the period from flowering to maturity, and particularly during the final stages of this period, are of greatest importance. The *rate of drying out* of the grain is apparently the main seasonal factor in determining the character of the endosperm. Definite correlations between rainfall during the flowering month, October, and yield, have been established, thus supporting the assumption that the flowering stage is a critical period in the life of the plant.

7. Soil type, particularly in regard to the *rate of drying out,* has a marked influence on the character of the endosperm of the grain. Plants grown on soils which dry out rapidly tend to produce grain of a translucent nature.

8. Nitrogenous fertilizers, applied either at seeding, or in the spring, increase the percentage of translucent grains occurring in the sample, irrespective of whether the nitrogen is applied as nitrate or sulphate. Superphosphate has no effect, except in the case of heavy dressings under adverse seasonal conditions. Potassic fertilizers decrease the percentage of translucent grains in the sample. The total nitrogen content of the grain is unaffected by dressings of nitrogenous fertilizers, except in the case of spring applications of nitrate of soda. Applications of superphosphate or potassium sulphate have no effect. Weight per 1,000 grains is unaffected by normal dressings of nitrogen, phosphorous, or potassium, but is decreased when excessive amounts of manure are applied.

9. Translucency of endosperm can be induced by the harvesting of plants in an immature state. As maturity proceeds, the percentage of translucent grains in the sample decreases, the rate of decrease being determined by the *rate of drying out* of the plant, and the grain in the plant. Weight per 1,000 grains, and the total nitrogen content of the grain are unaffected by the time at which the plants are harvested, after the grain is fully developed.

10. The percentage of translucent grains occurring in the sample is determined to a large extent by the length of the period between flowering and maturity. Any increase in the length of this period is accompanied by a decrease in the number of grains having endosperm of a translucent nature and a corresponding decrease in the total nitrogen content of the grain. The weight per 1000 grains is unaffected.

11. The amount of seed sown per acre has no effect on the endosperm of the grain when early sowing is practised. When plants are sown late, the percentage translucency of the sample increases as the rate of seeding is increased. The total nitrogen content or the weight per 1000 grains is unaffected in either case.

12. Late seeding results in the production of grain having endosperm of a translucent nature. Total nitrogen content is unaffected, but weight per 1000 grains is decreased, particularly when the rate of seeding exceeds 90 lb. per acre.

13. A positive correlation has been established between percentage translucency and weight per 1000 grains, but none was found to exist between percentage translucency and total nitrogen content. In view of this it is inadvisable to place too much reliance on the appearance of the grain as a guide to milling and baking quality.

14. Applications of superphosphate result in increased numbers of heads per foot, and grains per head, and in large increases in yield over the plots receiving no manure. Dressings of nitrogen and potash, while increasing the number of heads per foot, are responsible for decreases in the number of grains per head, and for slight decreases in yield. Applications of nitrogen in spring have no effect on the size of head or on yield.

15. The variety, Free Gallipoli, is heterozygous as regards size and shape of grain, and selection work, based on these characters, has yielded very promising results.

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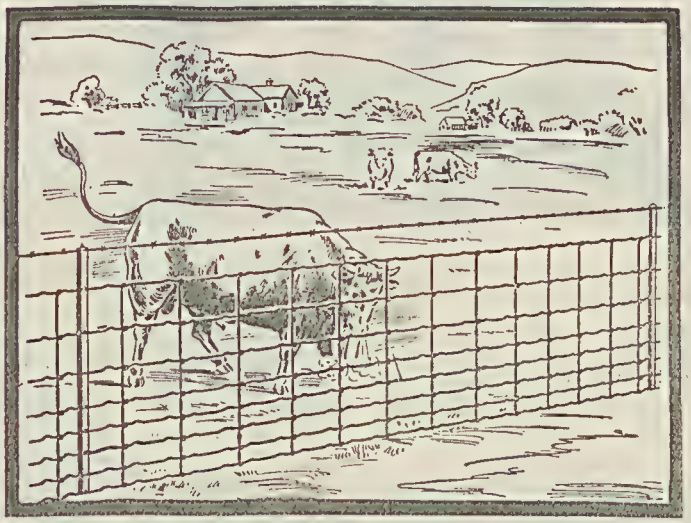

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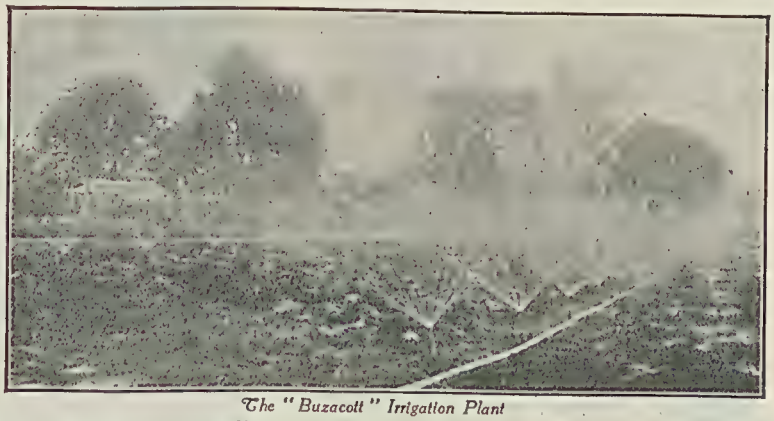

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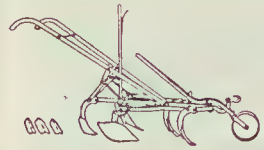

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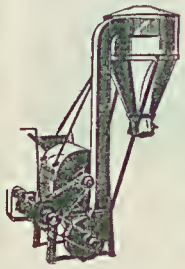

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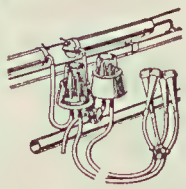

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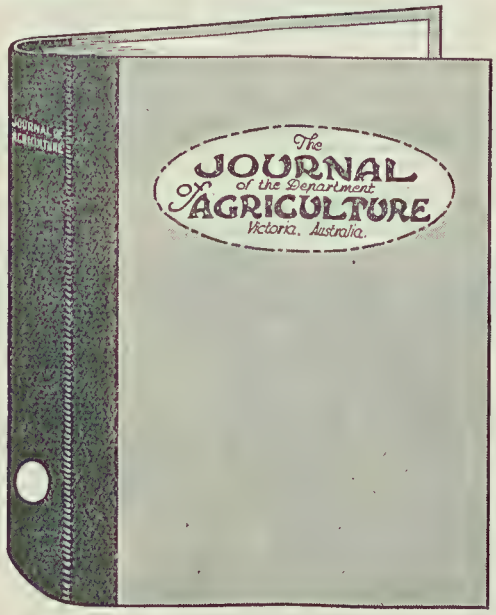

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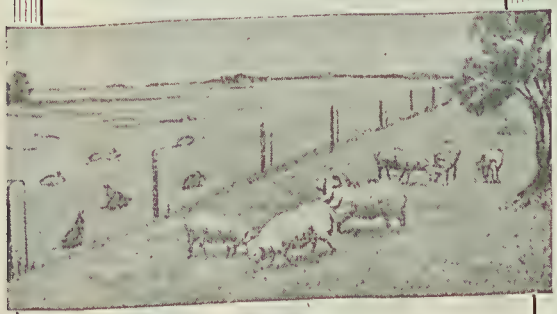

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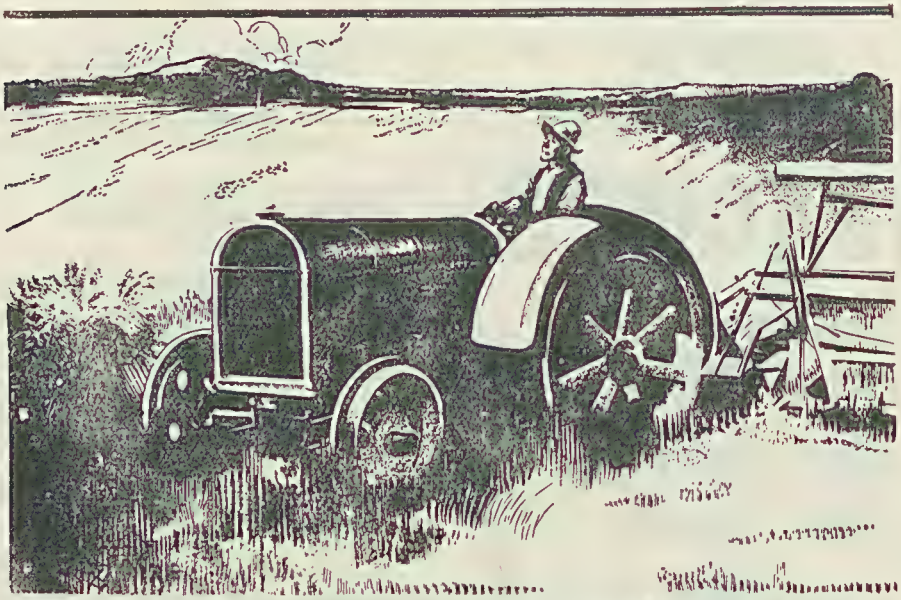

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3. BULL CALF - - - - Dropped 23rd July, 1932

Sire: VICTORIA DOUBLE TOP (1354) *Dam:* VICTORIA PATTI OAK (3766)

This is Victoria Patti Oak's first calf and the record of her dam (Victoria Pattibelle) is 13,476 lbs. milk and 460 lbs. butter-fat, with a 3·41 % test, for 273 days; and for her full lactation period of 365 days, 15,341 lbs. milk and 525 lbs. butter-fat with a 3·42 % test.

Being a heifer's bull calf,

Price: 10 Guineas f.o.r. WERRIBEE

Inspection cordially invited. For further particulars apply to—

THE DIRECTOR OF AGRICULTURE, MELBOURNE, C.2; OR THE MANAGER, STATE RESEARCH FARM, WERRIBEE

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